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ABSTRACT

The goal of the Educational Technology Center (ETC) Computer-based Conferencing Project has been to explore the potential of computer-mediated communication to support teachers in collegial exchange about their subject and practice, and to develop recommendations for future applications and management of such conferences. The purposes of this study were to describe the kinds of exchange in our own networks; to identify influences on one particular kind of exchange--discussion of teaching practice; to draw upon these findings and information about other similar networks; and to develop recommendations about choice and design of future applications of computer-based conferences for teachers. Discussions include: (1) research design and methods; (2) descriptions of the Science Teachers' Network and the Laboratory Sites Network; (3) a comparison of the two networks; and (4) recommendations for common interest networks. (CW)

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TALKING ABOUT TEACHING, BY WRITING: THE USE OF COMPUTER-BASED CONFERENCING FOR COLLEGIAL EXCHANGE AMONG TEACHERS

Technical Report

January 1989

U.S. DEPARTMENT OF EDUCATION
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TALKING ABOUT TEACHING, BY WRITING:

THE USE OF COMPUTER-BASED CONFERENCING

FOR COLLEGIAL EXCHANGE AMONG TEACHERS

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TABLE OF CONTENTS

1. Introduction 1
   The Science Teachers' Network 2
   Research Goals and Approach 3

2. Methods 3
   Implementation of the Lab Sites Network 4
   Implementation of the Science Teachers' Network 5
   Sampling 6
   Data Collection 7
   Data Analyses 8
   Survey of Similar Networks 8

3. Results and Discussion 9

   Science Teachers' Network 9
      Nature of Membership 9
      Growth of Network Activity 10
      Public and Private Mail 10
      Participation of New and Old Members 10
      Nature of Communications 11
      Motives for Use 20

   Laboratory Sites Network 21
      Frequency of Use, Content of Exchanges 22
      Access 23
      Motives for Use 23

   Comparative Analyses 24
      What Factors Promote Discussion? 24
      Access 25
      Knowledge of Basic Skills 25
      Motivation 25

4. Recommendations and Conclusions 26

   Recommendations for Common Interest Networks 26
      Membership Criteria and Size 26
      Ways to Structure Discussion 28
      Databases 29
      Supplementary Communication 30

   Recommendations for Common Task Networks 30

   Choosing Applications 31

References 32
Appendices

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INTRODUCTION

The goal of the ETC Computer-based Conferencing Project for the past two years has been to explore the potential of computer-mediated communication to support teachers in collegial exchange about their subject and practice, and to develop recommendations for future applications and management of such conferences.

Asynchronous computer-based conferencing has several unique characteristics as a medium: participants can read and write messages at whatever time is convenient for them, messages are available almost instantaneously even over long distances, and messages can be sent to groups as well as to individuals. For over a decade, operating on mainframe computers, the medium has proved useful to support a sense of professional community in geographically dispersed groups in business and academia. It was therefore natural for ETC to consider, when planning it's agenda for New Technologies Research in 1984, whether computer-based conferencing could also provide teachers with a sense of professional community and an opportunity for collegial exchange. The isolation of science teachers in particular, from ongoing developments in both science and science teaching, and from their peers, was reported to be an acute problem and was one we wished to address (American Association for the Advancement of Science, 1982; National Science Foundation, 1985).

Our initial concept of "collegial exchange" had two aspects: "information sharing" and "discussion". By the latter, we meant interpreted or personalized information presented in a context of social interaction. For example, we hoped that a teacher might describe not only the contents of a lesson or text, but the nature of his or her experiences using it. If discussion developed, perhaps conferencing could prove to be a new vehicle for staff development -- a means to revitalize, rather than merely to inform teachers' practice, through dialogue with other teachers and scientists.

In 1985 when the project began, and since then, the opportunity for teachers to communicate electronically has increased rapidly as microcomputers and modems have become less expensive and increasingly available in schools. With the sudden availability of the hardware, more and more network projects, of various types, have sprung up. But only recently have reports of these varied applications become available, and communication among researchers widespread enough, to allow notions about the influences on communication in this medium and to develop from a broad base of research. The two years of the ETC Computer-based Conferencing project reflect this situation: in the first year we implemented a single network. In the second year we have broadened our own experience by trying out an additional, different kind of network, and by seeking to learn from other researchers making similar efforts.

The Science Teachers' Network

The Science Teachers' Network was initiated in December 1985 to see how teachers might use a conferencing system that was designed and managed to facilitate discussion. Our goal was an electronic "conference" -- an arena for discussion -- as opposed to an electronic "bulletin board", as message exchange systems are often described. Because there appeared to be no system which was both easy to use and designed to facilitate discussion at the time, ETC designed new conferencing software to do so, called Common Ground (see Hancock, 1985, provided in Appendix A). The conference was moderated along lines suggested by previous experience at the Western Behavioral Sciences Institute (Feenberg, n.d.) by an experienced staff developer, graduate student in interactive technology, and four teachers.

The system did prove very easy to use, and participation rates and teachers' interview responses showed that they found the Network a valuable source of information and contact with other teachers. We were also able to learn how teachers themselves construed the network, and about a number of influences on participation (Katz, McSwiney & Stroud, 1987).

We were surprised, however, that teachers exchanged messages mainly about relatively discrete points of information and only sometimes offered personal views or discussion of more abstract points. The concepts of network use that teachers spontaneously offered in interviews revealed an interest in specific information, as well as "contact" with others, and "sharing ideas". The study led us to wonder whether reliance on specificity was a function of the medium itself, of inexperience with the medium (Kerr & Hiltz, 1982; Kiesler, Siegal & McGuire, 1984), or of some initial shyness due to teachers' lack of acquaintanceship with each other.

Understanding the source of teachers' reliance on specificity had important practical implications, specifically, implications for choosing applications and knowing how to manage future networks. If members of a common interest network are motivated primarily to have access to a large variety of specific information, a large membership may be needed, and/or experts who have this information. However, if members want mainly to discuss information, and will enter into discussion only when they feel well-acquainted with each other, then a different management policy may be required, such as a small membership, or forms of social facilitation on-line or in person. Therefore it was important to understand the source of members' reliance on specificity.

RESEARCH GOALS AND APPROACH

In pursuit of the general goals expressed at the beginning of this report, the first year of research had led us to note and wonder about specifity in message content. To understand this phenomenon better required us to look at it from several angles, and in particular, to examine its occurrence in contexts which the presence of suspected influences on it varied. We therefore proposed to (1) examine changes in use of the Science Teachers' Network over time; (2) moniter use of another Common Ground conference in which members were more acquainted and worked on some common tasks; (3) analyse examples of discussions among teachers; (4) survey other networks and reports of networks which aimed to promote colleagial exchange among teachers. The analytical steps we took toward these different kinds of data were as follows: (1) to describe the kinds of exchange in our own two networks; (2) to identify influences on one particular kind of exchange -- discussion of teaching practice; and (3) drawing upon these findings, and information about other similar networks, to develop recommendations about choice and design of future applications of computer-based conferences for teachers.

An opportunity to moniter a network which contrasted with the Science Teachers' Network in members' acquantaintanceship and commonality of activity was available at ETC in the new Laboratory Sites Network. The Laboratory Sites Project was established in 1986 to study the process of implementation of several ETC teaching innovations being carried out in five schools. A network was set up in order for teachers from the separate schools who were working on the same teaching intervention to share experiences with each other. The teachers also had on-site support through visits with a veteran teacher (one with prior experience with the new materials), and held group meetings about once a month. In addition, two large meetings of the entire project were held. Thus teachers had much more in-person contact that members of the Science Teachers' Network, and also pursued an activity in common.

METHODS

The investigation thus required operation of two networks -- the continuing Science Teachers' Network, and the new Laboratory Sites Network -- and means to examine the goals and nature of interactions between participants in each. To do this we developed descriptions of (a) each network's social structure and history (including membership, nature of contacts between members); (b) the technical/logistical features of each network such as members' technical skills and ease of access to equipment; (c) members' concepts and expectations of the network; (d) network participation, in terms of frequencies of log-ins, reading and writing by members; (e) how members actually read and write messages during their sessions; (f) the communicative features of messages and (g) the communicative features of discussions.

IMPLEMENTATION OF THE LAB SITES NETWORK

The Laboratory Sites Project members consisted of teachers and staff who would try out three different teaching interventions in five secondary schools in the Boston area. The three interventions consisted of (1) a year-long course in geometry based around the Geometry Supposer and an approach to learning geometry through inductive thinking (7 teachers); (2) teaching the physics of heat and temperature and thermal equilibrium with the aid of lessons and microcomputer-based laboratory equipment developed by ETC and Technical Education Resource Center (7 teachers); and a one-semester "metacourse" to facilitate the learning of programming in BASIC, consisting of nine lessons to be interwoven into the teacher's existing course (7 teachers). In addition to the head of the project as a whole, each group had a research leader to oversee the research on each intervention, and an adviser, who was a teacher with experience in using the intervention itself or similar materials. In addition, there was a support person at each school to oversee logistical matters that would arise at the site itself. The project is fully described in Wiske (1988), and the implementation and use of the network is more fully described in Appendix B.

The 38 Lab Sites Project members were enrolled in a Common Ground network in early September. Through the generosity of Apple Computer Inc. each of the five participating schools was provided with an Apple computer and modem. ETC staff decided that all members should use the same communications software so that staff and members could learn skills more quickly. Commworks was chosen for this purpose, because it would allow sending and receiving files that were created in the Appleworks wordprocessing/database software.

The contacts among Project members consisted of several meetings of the entire Project, as well as meetings approximately once a month of each subgroup, visits of advisors to schools, and contacts among teachers within schools. The features of the Common Ground network and its potential as a convenient way for members to share information about their work was presented in the first meeting of the Project in June, together with a demonstration and some hands-on training. Once the equipment was set up in schools, an ETC assistant also went to the school to help teachers learn how to log in, read and write messages. Network staff members attended one meeting of each subgroup at two points in the year to consider with members how the network might aid their work, and additional training was also offered. Midway through the year, an interview with leaders, advisors and about half the teacher members of each group was also an opportunity to ask members about the priorities they saw in their work and how a network might serve them.

When visits to schools for training, and conversation with teachers, showed that access was an obstacle to their use (in terms of both convenient access to the computer at their school, and having enough time during the school day), ETC decided to try to improve this situation by providing every member of one group with computers to use at home. The Geometry group was chosen because they seemed to have the most use for discussions between meetings. By February 7, Apple//c's and other computers were provided to each member of that group. In addition, three of the schools were given Hewlett Packard portable computers to be loaned to teachers on a rotating schedule.

The public discussion areas, or "forums" as they are called in Common Ground, were one forum for each group, as well as a forum for site support members ("liaisons"), for general notices, for technical questions, for members' biographical sketches, and, in response to a request of the Programming group, for programming exercises.

A fuller description of the implementation of the network is found in Appendix B.

IMPLEMENTATION OF THE SCIENCE TEACHERS' NETWORK

The Science Teachers' Network established in the fall of 1985 consisted of about 75 secondary teachers who had applied for membership on the basis of an invitation and description of the Network sent out to all district superintendents and science department chairpersons in eastern Massachusetts. The purpose of the network was described as "reducing teacher isolation from both current issues in science and from colleagues with whom they might exchange ideas about the teaching of science." During the spring, four guests scientists/science educators, and four teacher moderators also facilitated the Network, along with the ETC staff who included an experienced staff development specialist, and two researchers. A report of this period was prepared during the summer of 1986 (Katz, McSwiney & Stroud, 1987).

The Network was left running during the summer and fall but staff did not attempt to facilitate it. There was a low level of participation, mainly announcements and some discussions with lab safety consultant and guest James Kaufman of Curry College, and environmental education specialist Ralph Lutts of the Trailside Museum. During December 1986, we "re-started" the network. Letters were written to old members encouraging them to log in and to suggest the network to other interested science teachers. In addition, a letter and application forms were sent to district superintendents and science department heads (Appendix C).

During January and February 40 new members were enrolled, and this number reached 56 later in the spring. Applicants were sent a passwork and manual, and were invited to a gettogether in

February for dinner, a guest speaker, and a demonstration. Because of bad weather this gathering was postponed until March 2. As last year, the only technical help provided to members consisted of this meeting (about 30 members attended), phone help, the Common Ground manual, and questions exchanged over the network itself. During March and April additional guests were enrolled: Prof. Roy Glauber and some of his graduate assistants from the Dept. of Physics, Harvard University, agreed to answer questions that might arise; and earthquake expert Fr. Skehan of Boston College Weston Observatory also enrolled. In addition, following the example of several other collegial exchange networks, ETC staff developed a one-page newsletter to draw members' attention to events and discussions on the network. This was sent out twice in the Spring.

The forums on the network included four subject areas -- Physics, Chemistry, Earth Science and Biology -- and forums for technical questions, for software discussions, for biographical sketches, a notice board, a calendar of events, literature reviews offered by members, for discussion of teaching, for messages regarding the network community, and on safety issues. The subject area forums had voluntary teacher moderators, who were paid a small fee, and the others were moderated by staff or guests.

SAMPLING

Time Period

The networks were observed and printouts maintained for the period September through early July; log file data (see below) were analysed for the period January 1 through July 6, 1987, for both networks, which was the period in which new members and guests joined the Science Teachers' Network, and in which the majority of activity, and all teacher writing, occurred in the Lab Sites Network.

Sample of Members

Data on participation (logging in, reading and writing) were examined on all members of each network; interviews were collected on only a few as the goals of the interviews did not require information from the complete membership.

Sample of Discussions

The discussions selected for analysis were those which would best represent teachers' participation; therefore discussions in which guests or advisors were the principal interactants were not analysed but all other existing discussions were considered.

DATA COLLECTION

The project goals required collecting the following data:

(1) Host Machine Log Files: the host machine is programmed to collect a complete record of the time and duration of each log-in and what messages were read and written (excluding the text itself of the message).

(2) Record of Messages: Printouts of message provide a complete record of messages written on the networks.

(3) Network Diary, Staff Discussions: one staff member kept a journal summarizing the interactions on each network every two weeks, focusing on "who talked to whom about what". In addition, the five central staff members had different areas of expertize from which to interpret the interactions that were taking place.

(4) Observations of Host Machine Screen: beginning in April for an eight week period, three observers took turns observing the host machine screen during randomly scheduled periods from 9am to 5pm weekdays. They recorded the sequence of actions of anyone who logged in, as well as any difficulties that were observed in using the network.

(5) Teacher Interviews:

(a) Lab Sites (Appendix D): two rounds of interviews were conducted with Lab Sites members, one during February (about half way through the school year); and one at the end of the year (during late June). The goal of the first interview was to learn what Lab Sites' members priorities had been in their work and whether and how the network had served them so far, or might best be able to in the future. The project leader, advisor, and about half of the group members were interviewed for each of the three innovations, insuring that teachers from all five schools were included. In the second interview, six teachers who had been especially active users were interviewed about similar issues and about particular exchanges.

(b) Science Teachers' Network (Appendix E): five teachers, including some who tended to write alot and some who were mainly readers, were interviewed about what motivated their network use, and about particular interactions that had occurred on the network.

(6) Questionnaires:

(a) Lab Sites Network (Appendix F): all members returned a form which asked for information about the extent of wordprocessing and other previous computer experience.

(b) Science Teachers' Network (Appendix G): 24 members returned a questionnaire in which they indicated on a scale the degree of their previous acquaintanceship with each other member

of the network, as well as indicating which members they considered to have some kind of special expertize. The questionnaire was also used last year and was found to have adequate test-retest reliability.

DATA ANALYSES

In addition to the descriptive analyses listed above, the following analyses were carried out:

(1) Levels of Participation: these were established for each member and for the network as a whole by looking at log-ins, reading and writing acts for the network as a whole, and for each member. Because members joined the network at different times, to compare the participation levels of members it was necessary to compute rates of participation. For example, a log-in rate was computed by dividing a member's total number log-ins by the number of weeks after the first log-in. Other scores computed were the ratio of messages read to messages written, and the proportion of all messages written that were public messages.

(2) Effects of experience with the medium on participation rates and type: for the Science Teachers' Network, using log files and other data, comparisons were made of new and old members' pattern of participation in terms of (a) dropout rates; (b) frequency of logging in; (c) type of use (reading vs. writing); in addition, the writing of several members who wrote enough both last year and this year was examined developmentally for any changes in typical message length, complexity of topic, degree of personalization, and other features.

(3) Communicative features of discussions: discussions were defined as any chain of messages on an identifiable topic; all from the entire network period were discussed in which teachers were major participants (rather than discussions dominated by guests or advisors); several exchanges were then analysed in the manner of discourse analysis, attempting to identify the underlying communication goals of messages, and how these and other topics evolved with subsequent contributions (Appendix H).

(4) Influences on the presence and development of discussions: These inferences were developed out of message analyses, discussion analyses, teacher interviews, and analysis of the total context of communication for both networks.

SURVEY OF SIMILAR NETWORKS

We wished to study other networks for colleagial exchange among science teachers in order to have a broader base on which to draw our conclusions. This was done through a review of the literature, by logging in to networks which seemed to have similar purposes, and through meetings with other researchers. The most comprehensive and current list we could obtain of

education networks was that developed and maintained by Pat Haring and Robert Shayler on The Source information service (document PUBLIC 52 DIRECT), which provided brief descriptions and phone numbers for 110 electronic bulletin boards and conferences. These networks were "visited" and searched for any forums for discussion among science teachers. There were two outcomes of this survey: (1) of what could be observed on the networks, there were few networks in which discussion of science or practice was going on between teachers; (2) it was very hard to get enough information about these networks to make any interpretation of their use. Therefore we focused our attention on three networks for which more information was available, and whose design, purposes or system offered interesting features. The science teachers' conference of the EIES network, a project of the New Jersey Institute of Technology, was of interest because the group reported successful use of a network to support implementation of AAAS-developed science units in schools. The MIX network of McGraw-Hill Publishers was selected because forums revealed considerable interaction among science teachers in the middle and western U.S. At Bank Street College, the Earth Lab project and a network used to support test sites for the Voyage of the Mimi science unit were of interest. In the former, a network was used by teachers and students to allow them to work together on science projects, and to integrate science activities into the curriculum, in ways not otherwise possible.

We learned as much as possible about the systems, goals and use of these networks through their reports, meetings with researchers, and network transcripts (which were available for the MIX and EIES projects).

RESULTS AND DISCUSSION

SCIENCE TEACHERS' NETWORK

Nature of Membership

The membership consisted of old members who had logged in regularly in the past, and new members most of whom had never used a network before. In December 1986 old members were notified by mail that we were reorganizing the network for the coming year and if they wished to continue their membership they should log in by a certain date. Passwords of members who did not do so were deleted from the system; in the case of a few active members we called them first to insure that they didn't wish to continue. About a third of last year's regular users did not join again for this year. At about the same time, letters inviting new members were sent out to district superintendents and science department heads in eastern Massachusetts. Any interested science teachers was invited to join. As a result, 56 teachers applied. Applicants were immediately sent a password, manual and other materials. Some old and new members were able to meet face-to-face in the gettogether on March 2.

By May, 151 persons were listed on the "Who Is" list of all persons who had passwords to the system, including persons who were given a "visitor" status, and teachers who had applied but did not log in. Those who logged in included 49 secondary teachers, 4 guests, several visitors including two university teachers who had set up networks themselves for science teachers. Sixteen of the teachers in the group were new members, leaving 33 who had joined last year.

The group of people who were "visible" on the network, using the criterion of writing three of more messages, was a smaller group -- about 30.

These figures contrast with last years' membership size of 75 teachers and guests, of which about 50 wrote three or more messages. Thus the current years' group was smaller by about 20 persons, whether calculated as all who ever logged in, or those who wrote three or more messages.

Growth of Network Activity

New members made their first calls to the network throughout the period January through early April, and about half continued to log in while the others discontinued use within a few weeks. This is comparable to the 40% "dropout" rate we observed in the first year of network operation. However, the old members (who represented two-thirds of last year's members) were not much more persistent as a group in their pattern of logging in than the new members. About half (18/33) were regular users, 6 were sporadic users, and 9 discontinued use. The number of messages written by members (other than ETC staff) ranged similarly in each year and averaged the same -- 21.

Public and Private Mail

Excluding messages sent by ETC staff, a total of 961 messages were sent, of which 44% were public. This is comparable to last year's network in which 37% of messages were public. There was no difference between years in the percent of an author's messages that were public vs. private. In each year, there were a few individuals who wrote many public messages, but for most teachers, public messages were 20-40% of all messages. This suggests that becoming more familiar with the network community through using it did not increase public writing, and that the topics being discussed were a more important influence on participation.

Levels and Patterns of Participation of New and Old Members

As noted above, the "dropout" rate this year of new and old members was approximately equal. Similarly, the variability in log-in rates and type of use (amount of writing relative to

reading) was equal among new and old members who showed continuing interest. Most logged in about once a week or slightly less often; and a few very active users logged in about every day. In both groups the number of messages read for every message written ranged from 2 to about 100.

It was of central interest whether there would be any developmental changes in the pattern of use of old members that would suggest an effect of gaining greater familiarity and comfort with the medium itself, or with the network users. Would old members log in more frequently in the second year? Would they do more writing? Of the 21 old members who were not moderators and did not dropout, we found no change in the pattern of loggin in between years. Of the 10 members who logged in more than 8 times in each year (enough to study reading/writing activity), 6 kept the same ratio of writing to reading (3 were active writers, 3 did little writing and alot of reading). Of the other four, 2 wrote more, and 2 wrote less than last year. Thus there was no discernible overall trend toward increased writing with experience.

Finally, we examined the writing style of the old members who had written a number of messages in both the first and second year. Two researchers examined the messages for changes in the following: length of messages; preference for specific or general topics; extent of expression of affect/opinion; elaboration of concepts; use of colloquial expressions; reference to outside authorities. They agreed there were no great changes over time in a member's style of expression. While individuals differed greatly in their styles, each maintained their basic individual style throughout. There was no trend over time from short, specific messages to longer, more abstract or more personal ones.

All of the above data suggest that familiarity with the medium (or with each other) is not a cause of specificity of message content. However, specificity may be a response to users of the medium to the lack of opportunity for visual feedback to clarify communications, or slow response time for written clarifications to occur. Furthermore, the data suggest that members' choice to continue or discontinue using the network was based mainly on whether the topics they saw there interested them, and that becoming more at ease with the medium itself, or with other members of the group, was not a significant factor in continuation.

Nature of Communications

These analyses aimed to understand <u>how</u> members try to communicate with each other in a network in which exchange of information and opinion is understood to be the goal, and how effectively communication takes place.

Two kinds of analyses of the content of communications were carried out: (1) identifying the major characteristics of messages as communicative acts; and (2) identifying the major characteristics of "discussions" that occurred on the network, attempting to define the goals of the participants and to see how these were negotiated in the course of the exchange.

Message Characteristics

Identifying the characteristics of messages that seemed to effect them as communicative acts led us to notice that messages differed in the way these characteristics were displayed, that the characteristics were actually dimensions of variability in the nature of messages. While we were not able to find out whether any one style of message was more effective in producing a response (because many responses occurred in private mail, which we did not moniter), this analysis, combined with the analysis of discussions, led to some conclusions about how conversations take place on a network for collegial exchange. These have implications for network management which are presented in the Conclusions.

1. Specificity of topic

Messages could be differentiated according to whether the topic(s) were very specific and easily identifiable, or more complex and open. Examples of the former type are: (a) announcing a science fair or (b) job opening; (c) providing the phone number to call for certain information, (d) asking for suggestions of what to teach in chemistry class on the days before vacation, (e) asking for information on the long term health effects of DDT on humans, (f) asking for experiments to do on ultraviolet light. Some examples of the latter are: (g) women and nature, (h) today's educational mobilization, (i) disadvantaged students, (j) using live animals in the classroom.

The more specific topics involve concepts whose boundaries are clear and definite to most people in the given community, resulting in greater potential for it to be easily understood by a reader, as in the first group listed above. Within these, however, there is potential complexity in what is being asked <u>for</u> about the topic. For the first three, the information given or requested is itself simple and it is easy to understand the question and to write the answer if it is known. For (e) and (f), although the initial topic may be identifiable, the answer may be complex. In topics that are initially complex in themselves, on the other hand, such as (g) - (j) above, the boundaries of the topic and the directions that a discussion could take are far more open and will require more extended writing and clarification for meaningful discussion to take place.

2. Social engagement

Messages differed in how explicitly they made a request or reply. Yet messages perceived as part of a "discussion" did not need to contain explicit statements of request, or identify themselves explicitly as a reply. For example, as in face-to-face conversation, statement of an opinion in itself invites a response. This dimension seems to intertwine with the last described below, expression of affect and opinion.

Messages that were neither requests nor replies were the announcements and descriptions that appeared in certain forums in particular: notice board, calendar, literature review, and guest forums. Some of these contained opinions as well. Even announcements are, ofcourse, replies, in the larger sense that they address what is understood to be of general interest to members of the network. Lengthy statements that were initiated independent of any request were found especially in the guest forums or literature review forums. Again, these were on topics assumed to be of general interest.

In contrast with some other systems, Common Ground does not include any special facility to upload and download independent documents created in other wordprocessors. Also, to encourage discussion rather than uploading and downloading of long texts in the Science Teachers' Network, we set the limit for message length to 100 lines.

Thus within the underlying agenda of the network of interaction about topics of common interest, there was variation in the degree and explicitness of social engagement in messages.

3. Formal vs. informal style

It was possible to characterize the writing in messages along a crude dimension which could be called "formal-informal". Informal writing included short messages which appear to be quickly composed, while a more formal style of writing also occurred, in which the message appeared to be composed more carefully, taking more time and thought in the writing of it. These messages had more of the characteristics associated with writing generally, such as greater elaboration of concepts. A message also seemed to acquire formality through reference to outside authorities, especially written sources. It acquired informality through use of colloquial expressions. Thus the styles of expression we observed ranged on a dimension that seems to associate to the range from oral to written to published communications. This variety is in contrast with some early research on electronic mail systems which concluded that the medium will always produce an informal talk style of communication. The variety we observed may relate to the communicative purposes and roles of members. For example, guests experts are obliged to offer expertize and may bolster it by more

thoughtful writing with references to published sources (see examples below).

4. Expression of personal opinion or affect

Finally, it was possible to distinguish degrees of personalization of messages -- a message might contain more or less expression of personal opinion, affect, or personal experience.

Examples 1-4 below are messages which differ along the four dimensions described above.

Example 1 is specific and informal. It appears to be quickly composed, and uses informal language such as "want to swap?". It explicitly asks for response, yet does not contain personal opinion or affect. Rather it asks for several kinds of very specific information on topics which are probably easily identifiable and understood within the culture of science teachers.

EXAMPLE 1.

from eddiew
to earchsci physics biology chemis
re: UV LIGHT

I AM LOOKING FOR SOME EXPERIMENTS TO DO WITH UV LIGHT. DO YOU KNOW OF LOCAL ITEMS THAT FLORESCE? DO YOU HAVE ANY SPECIMENS (ROCK OR OTHERWISE) YOU WANT TO TRADE? DO YOU KNOW OF A SOURCE(S) OF UV FILTERS AND SUPPLIES? i HAVE AN EXTRA 2' FLR. UV FIXTURE AND MANY MINERAL SPECIMEN-WANT TO SWAP? EDDIEW

In contrast with this request for specific information, stated briefly and without any personalization, is Example 2 in which a good deal of specific information is provided but with added evaluation by the author, who was a network guest. The topic required a lengthy message in order to provide fully the information of interest. The writing is also more developed than in the example above, although it still includes some informal language, e.g. "It is not your average 'pretty picture' nature magazine". Although the message includes the author's personal evaluation in several places, its main goal seems to be to provide information. This interpretation is supported in that the author states that he has made "comments" on the topic in another network message, which we show as Example 3.

EXAMPLE 2.

msg no. 3980 filed 1:41 PM Jan 11, 1987

from harry
to litrevie
re: ORION NATURE QUARTERLY

ORION NATURE QUARTERLY is a relatively new magazine devoted, as the title implies, to nature and environmental themes. It is high quality, with really fine color photography, at a reasonable price -- 4 issues/yr, $14.00

Each issue is devoted to a theme: snow, Gaia, new approaches to nature_____ (the current issue), etc. Upcoming issues will address: Architecture in relation to the natural environment, Migration, Water, and Encouraging nature appreciation in children. The articles are well written, substantive, and interesting. It is not your average "prettypicture" nature magazine. It is well grounded intellectually, as well as accessible to the reader. It is first-rate.

The current issue (Winter 1987) should be of special interest to educators. The contents are:

THE COOLING TOWER IN THE GARDEN: A CHALLENGE TO EDUCATION. What is the responsibility of teachers in the humanities, in a world dominated by science and technology?

TEACHING WILDERNESS VALUES. How one college English teacher uses American wilderness literature to help students find their own relation to the land.

VOLUNTEERING FOR DISCOVERY. About Earthwatch.

DRAWING ON EXPERIENCE. The person who draws what he or she sees will see much more.

THIS WAY TO THE NEAREST WILDERNESS. Why two nature educators decided to write a new kind of field guide. (Written by and about Don and Lillian Stokes and the Stokes Nature Guides series of books.)

BILOGY, THE STUDY OF LIFE. The humane treatment of animals is just one step toward making biology classroom a place where students learn reverence for life; far more basic changes are in order. (See my comments on this article in the Biology forum.)

A useful contrast to this is the same author's "comments" message, Example 3. It is characterized by the same, rather fully developed writing style, but more personalization is implicitly present in that the topic has been formulated in terms of issues. The formality of the writing is increased by its inclusion of quotes from a published written source. As in the second example, it includes explicit statement of the author's opinion ("It is well worth reading") as well as emphasis on

issues. In presenting issues, which (by definition) express reflection and interpretation on the part of the writer, the message calls for a response in kind. Still, there is no explicit call for readers' response.

EXAMPLE 3.

from harry
to biology
re: USING LIVE ANIMALS IN THE CLASSROOM (Orion article)

The recent (Winter 1987) issie of ORION NATURE QUARTERLY included an interesting article exploring issues regarding the morality and educational effectiveness of animal experiments and dissection in the classroom. (See the "litrevie" forum, mag. #3980, for more information about ORION.) The article, "Biology, the Study of Life" was written by George K. Russell, professor of biology at Adelphi University. It is well worth reading.

The questions that he raises are not new ones for biology teachers. What is really being taught when students are required to dissect animals or conduct experiments that cause harm to animals? What is it that we are really trying to teach? What alternatives are available to us? Can and should we teach to stimulate a sense of wonder and delight regarding the living world, as well as "objective" information and scientific methodology?

Russell writes, "These conjectures lead me inescapably to the conclusion that invasive procedures and animal dissections have no place in the high school biology curriculum. Most young people of my acquaintance, especially those from urban and suburban settings, have little familiarity with living nature. An overly analytical approach, especially one in which animals are harmed or killed, tends to alienate the student and sever the affinities that make real learning possible. Taught by these methods, students learn the mechanics of life, but they do not establish the kind of caring, participatory relationship with the natural world which, I have tried to show, is the point of it all. Biology is, after all, the study of life."

Single copies of this issue (Winter, 1987) are avialable for $4.00 from:

ORION NATURE QUARTERLY
136 East 64th Street
New York, NY 10021

Annual subscription (4 issues) is $14.00.
-- Harry

Examples 2 and 3 were both written by a network guest. Guests are, by definition, persons considered to have expertize and to have the responsibility to present this knowledge on the network. The kind of writing that appears in both these messages can be seen as a function of the author's status as a guest, and of the two forums involved. Example 2 is from the Literature Review forum and follows and presents less personal interpretation, whereas Example 3 is from the Biology Forum which may be viewed by participants as an arena for more personal expression.

Example 4 was written by an active teacher member and falls somewhat between the two above on the extent of development of the writing itself, but is explicitly personalized and also explicitly asks for others' reactions.

Example 4.

msg no. 4265 filed 10:45 PM Feb 19, 1987
from drew
to teaching
re: CATCH 22 ??? - TODAY'S EDUCATIONAL MOBILIZATION....2+K

H.M. Levin, Stamford university, (in his reviewing "Low Tech Education in a High Tech World" in SCIENCE, 13 Feb 87, p799) suggests that our foreign trade deficit and low manufacturing competitiveness is NOT due to a poor labor force and their inadequate education, but is due to value of dollar, poor management decisions, etc. However Levin states our educational system is on a collision course with failure to have adequate occupational preparedness. Much stress is being put on "high tech" is spite of there being only 5% of U.S. jobs are technologically oriented that require 2 years or college or more. Most job growth is in low wage and low educational level such as clerical, retail, fast-food, and medical aide jobs. Occupations which have adopted microprocessor technologies have moved to lower skill requirements than before. That is less analytical and tech are now required in printing, banking, computer utilization, and electronic machine repair.

In addition over occupational misdirection of education, Levin continues that a major threat to the economy is that educational institutions have a tremendous number of disadvantaged students, 30% of present enrollments is U.S. schools have cultural differences, non-English languages, poverty, etc. such that they do not substantially benefit from their school years. They leave school lacking elementary skills in reading, writing, computation, and reasoning.

How is this is response to Levin's concerns? Instead of my teaching 108 students in 4 standard chemistry classes and 1 honors chemsitry class, the students be REDEPLOYED into 3

"CONTEMPORARY SCIENCE" classes, 1 std. chem, and 1 hon chem. The CONTEMPORARY SCIENCE would cover several topics in the year. The only two topics I can think of at the moment are FIRE FATALITIES (U.S. has about double the rest of the world in itsloss of life due to fires) and IMPLICATIONS OF DATA IN WORLD ALMANIC. In this new course I would soft pedal the topics molecules, moles, ideal gases, equations, molarity, and tetrahedron that are in "orthodox chemistry".

Would appreciate an reactions to the above.
i.e....think it would get administrative support?
.....think students would get a greater benefit?
.....if silence is appropriate, do you have some Catch 22's?

The above examples illustrate the range of message characteristics, but do not show how they function in communication. We were especially interested in how topics were negotiated among teachers. Would the more specific topics be easier to discuss? Would exchange of opinion be a more difficult task than provision of simple information, since it presumably involves not only description but an evaluation and justification of the evaluation? These questions were addressed by analysing examples of discussions.

Discussion Characteristics

In looking for examples of discussions, we searched both the Lab Sites Network and Science Teachers' Network. No examples of extended discussion were found in the Lab Sites Network. Many were available in the Science Teachers' Network, but most involved moderators or guests as the principal actors. The examples we selected for study were some which involved teachers as major participants (rather than those in which guests or moderators dominated). Four such discussions were analyzed in the manner of a discourse analysis, attempting to identify the intent of an individual's messages in a particular exchange, the other participant's interpretations of the sender's intent, and how the topic was negotiated (Appendix H).

Both specific and more general topics were the starting points for these discussions. The exchanges starting questions for specific information, however, contained some underlying ambiguity or issue which was taken up by respondents. Thus even specific questions were developed along what appear to be the personal agendas of those who chose to participate, and the responses did not necessarily address the specific interest of the initiator. Most contributions to the discussions contain ambiguities that allow the message to be answerable in a variety of ways, or contain a statement of opinion, which is similarly "answerable" in that a statement of opinion "calls for" another opinion.

For example, in the "textbook" discussion (Appendix H, pp. 2-7), what was being talked about was judged differently at different points by different participants. An initial inquiry about textbooks or computer software for low or average level biology classes quickly becomes a discussion described by a later participant as about "what to teach and how to teach it". Second, the written messages themselves did not always reflect the author's topic lines. Third, ambiguities in the messages, and the personal interests of participants, seemed to contribute to the emergence of new topics both for the initiator and those who engaged it at different points. All of the messages in this discussion were short ones which appear to have been composed quickly.

A similar core issue -- what to teach -- underlies two other discussions of chemistry curriculum, which began in quite different ways (Appendix H, pp 11-20). The first example begins with a rather long message ending with a proposal to change what is taught in chemistry to low and average ability students (Example 4 above). In this message, Drew summarizes several issues raised in a review by H.M. Levin of an article on education in SCIENCE magazine, and then presents his own view of a better science curriculum, asking for reactions. He gets three responses, one from a teacher and two from guests, all expressing some level of agreement with Drew, and continuing with additional points of view and with suggested approaches to the problem of appropriate curriculum. The discussion is successful in the sense that the initial issue, which was presented with some degree of elaboration, resulted in responses that were well elaborated by the respondents, especially the third.

The second example among the same participants becomes a very heated debate with remarkably different themes and tones In the second example messages are short and contain more colloquial language. The discussion is initiated by a short and provocative message:

> RE: Stoichiometry Why do we teach it? The only people who use it are chemists. Do chemistry teachers have trouble finding homework assignments without it?

This discussion becomes quite antagonistic; no resolution is reached by the two principle opponents, but three other members make attempts to "cool" down the discussion. The differences between this discussion and the former one may be due to the different styles in which they were initiated, or to the fact that they occurred in forums which had developed different styles (see Appendix H, p. 18-19). However, both are effective discussions in eliciting responses and statements of opinion.

These analyses lead us to think of computer-mediated communications in a collegial exchange network (where topics and interests are relatively openended) as containing a great deal of

ambiguity as a context for communication. In computer-mediated communication, obviously, we lack the means to easily clarify meanings that we have in face-to-face interactions, or even in oral interactions over the phone. In the latter, many paralinguistic cues in voice and body movements are available, which help to clarify meaning; in addition, the rapidity of voice interactions allows meanings to be clarified easily through questions. In computer-mediated communication a round of interaction may be slow, and responses are not certain or predictable. A rapid exchange might take place which could clarify a question, but seems less probable than in face-to-face interactions. It may be that participants react to this ambiguity by doing several things: (1) by chosing rather specific topics for messages; and (2) by using the inherent ambiguity as an opportunity for expanding topics in free-associative ways; (3) by using exaggerations of their usual individual strategies to establish authority or elicit responses, ranging from provocation to exhibition of scholarship. In addition, since a variety of styles of interaction seem possible, participants may be more vulnerable to modelling.

We are not proposing that ambiguity is a negative a feature of this communicative context but that it may be one that participants try to accomodate to in certain ways. As communicators, we are accustomed to dealing with ambiguity in daily face-to-face interactions as well. Let us recall that our ways of negotiating social interactions in daily life, as well as our enjoyment of literature, drama and poetry, are built upon our ability to interpret verbal ambiguity. Computer-mediated communications may present ambiguities which we respond to in particular ways.

It is clear in the ETC networks and from discussions with other network researchers that some people take quickly to telecommunications and enjoy the medium, while others find it unappealing. It may be that those who take it up enthusiastically are those who particularly enjoy the free-associative, openended kind of discussion that can occur.

Motivation for Using the Network

In interviews with teachers both last year (n=31) and this year (n=5), they expressed their primary interest as opportunity to communicate with colleagues. A secondary interest of a number of teachers was to learn about telecommunications.

Teachers' concepts about communicating with colleagues included getting specific information about teaching, which they expressed in terms such as "teaching techniques", "trade secrets", keeping "on top of the science field", and "information on texts, technical stuff, and events", as well as the general notion of access to colleagues, conveyed in phrases such as "staying in touch," " sharing ideas", "contact", and "getting to

know other teachers." As one teacher said last year, "Just to communicate with each other is wonderful. It made me feel part of a larger community. It was the first time I had access to my colleagues." Teachers expressed overall satisfaction with the network whether they used it often or infrequently, and whether they used it mainly for reading, or also for writing.

Last year and this year, only a few teachers expressed negative comments about the network when they were asked to describe how the network did and did not serve their interests. Several would have liked to download worksheets, to get more information in their field, or to have more discussion.

Some interesting thoughts about the quality of communication on the network were offered by one especially active user, who expressed his primary purpose as "peer interaction". He logged in at least two or three times per week, and sometimes more than once in a day. He felt that private mail inquiries were almost guaranteed a response, in contrast with inquiries made in the public forums, and that the answers in private mail were often more "pertinent to what the original request was". When one particular public discussion was used to consider the nature of discussions on the network, he noted that when just a few people were trying to "push their ideas" that this was a "turn off" and saw the sometimes sensitive debates as "people going off crazy". He felt that people's personalities emerged through their participation and he found himself evaluating them. He said that, at the beginning, he tried to keep his personality out of it, explaining that because it was a public network he felt a certain formalism was called for. He felt that he was forced to integrate more of his personality when discussion became more philosophical in nature.

These comments support our own notion that the medium, when used for fairly open-ended topics, has both advantages and disadvantages. The medium encourages short, rapidly written pieces, supporting a more free-associative kind of thinking and a colloquial style. Personal styles emerge in messages; yet clarification and justification of opinions depends on skillful written expression.

LAB SITES NETWORK

The analysis of the Lab Sites Network, presented in full in Appendix B, attempted to characterize the use of the network and interpret it in terms of project members' needs and opportunities for communication. This was done drawing on the Network staff's impressions of group meetings, conversations with teaching during training visits, teacher interviews, the record of members' reading and writing available in the log files, analysis of public exchanges from the message printout, and discussions with the two principal research assistants of the Lab Sites Project, David Niguidula and Joy Shepard. Since they had each devoted

nearly full-time work to the Project, their knowledge greatly enhanced the opportunity to make more informed interpretations of network use. The opportunity for collaboration with these Project members was an invaluable one.

Frequency of Use and Content of Exchanges

A total of 924 messages were sent from January through June by the 38 project members, with 86% being private mail. While most of the teachers logged in at least a few times, there was great variability among the teachers in the extent of their use. Six teachers sent no messages, 6 sent 1-5 messages, 3 sent 6-10, and 8 sent more than 10. The principal use by teachers was for reading and for sending private messages, and the direction of exchanges was between teachers and advisors, rather than among teahers. Since it was a policy not to keep any record of private mail, we can only report the direction of these communications, and what members reported about their use of private mail. It appears that the private exchanges were of the same basic nature as the public -- information was being asked for or given from advisor to teachers. This is consistent with the nature of teachers' task -- to learn new teaching techniques or approaches and put them to use in the classroom.

Exchanges among teachers themselves were less frequent than we had hoped for, but did develop, especially in the Geometry group, after teachers had access to computers at home. Whether this kind of exchange would have developed on the network anyway and was primarily due to their reaching a later stage in their own learning in which they felt they had developed experience worth sharing with other teachers, is hard to know. In other words, it is hard to separate out the effects of greater access from possible greater interest in communicating with peers, at this point.

We also found that examples of reflective thinking about the process of teaching and learning occurred in group meetings before appearing on the network. Such statements were heard in group meetings during the fall, when most teachers were just barely learning use of the network. Does this lag indicate that the medium itself is a difficult one for such thinking and writing, or is it merely an effect of our teachers' lack of having the basic skills at this point? In interviews, teachers themselves suggested that it would be better to learn telecommunications before learning the new teaching approach, and that trying to learn both at once, as they did during the fall, was too much effort. Some teachers did not have previous wordprocessing experience, and some did not even have typing experience. On the other hand, some teachers expressed reservations about the type of communication possible in the medium, stating that they wanted to "banter" back and forth and that wasn't possible in a network. Clearly they found the meetings a preferred place to exchange thoughts about their

work. In fact, the meetings may have met their needs to do so. However, it is possible to imagine that a computer network would become a more important communication medium for teachers who are geographically separated, need to communicate with each other about their work, and who can gain enough ease with the medium. The history of the QUILL experiment in Alaska (Bruce, Rubin & Barnhardt, in preparation) supports this view.

Finally, we present the comment of one of the advisors about the process of reflection on teaching by teachers. It was his feeling that reflective thinking on their practice is not normally called for in teachers' work, that teachers are called upon mostly to be receivers of information. Therefore to engage in reflection on their practice, while it may be a desirable and expected part of working with a new teaching approach, is a new and demanding task in itself.

Access

The arrangement for teachers to use one modem-equipped computer at each school was not convenient enough for these teachers to use it frequently; many stated that they did not have time to log in from school. In the group that did eventually have computers to use at home, use was much greater. But teachers' notion "not having enough time" also indicates that the task for which they would use telecommunications was not a central part of their teaching work, but was supplementary or peripheral to it.

Teachers' Motivation for Use

The network was used differently by the three groups, who differed in communication needs. The differences among the groups lead to the conclusion that, at least for teachers who are not yet very familiar with telecommunicating, a network will be used only when it supports their immediate work priorities, as they see them.

In two other cases in which a network was provided to facilitate implementation of new teaching approaches -- for Bank Street College's Voyage of the Mimi materials, and for the implementation project of Kimmel, Kerr and O'Shea (1986) on AAAS-designed science units, a similar conclusion seems to emerge. Teachers used the network for their immediate priorities in the classroom, rather than for more abstract or reflective kinds of exchange. The experience of Newman and others at Bank Street College has led them to see that, for telecommunications to be a tool for innovation in education, it must be a tool serving educational activities which themselves carry the innovation (personal communication). Thus their current application of telecommunications is to provide communications within and between groups which are carrying out collaborative projects as a part of a science curriculum. The activities

depend on the availability of the telecommunications.

COMPARATIVE ANALYSES

Comparative analyses using a small number of cases can generate hypotheses which then need to be tested with a larger number of cases. Certain comparisons within and across the ETC networks, and research on other networks, suggest hypotheses in the areas below.

What Factors Promote Public Discussion of Teaching?

As noted, messages among the unacquainted science teachers were often short ones on specific topics. Exchanges among the members of the Teaching Forum who were better acquainted, however, suggest that the information-sharing orientation of the unacquainted teachers may be a safe interaction strategy for unacquainted professionals that would change in different social circumstances. These teachers had trained together at Harvard Graduate School of Education the previous year, and had requested membership in order to keep in touch. As described in last year's report (Katz, McSwiney & Stroud, 1987), their social motivation was evident in their messages which contained greetings, reports of contact with other group members, and offers of help and sympathy. These teachers offered topics of a personal nature reflected in the topic lines they composed: "emotions," "feedback," "reflections." Messages sequences followed a single evolving topic rather than several unrelated topics. An independent network started this year for that program has been heavily used -- 1500 calls in two months. These teachers share their experiences in graduate school and their transition to new jobs -- more powerful common experiences than the other members of the Science Teachers' Network.

It is interesting, however, that the greater acquaintanceship and involvement in a common task of the Laboratory Sites participants did not result in more public discussion than occurred on the Science Teachers' Network. On the contrary, only 15% of Lab Sites messages were public, compared with about 40% in both years among the science teachers. The average number of messages written per member in Lab Sites and Science networks was about equal, as was the total number of messages in year 2; but use differed. This is explained in two ways. Lab Sites teachers were less dependent on the network for general discussion because they shared experiences at their monthly meetings. They wrote inquiries privately to their advisors rather than to peers because their adviser was more experienced with the new materials than peers. The current peer use also varied with schedules.

The Lab Sites teachers, like science teachers, needed information, and chose to obtain it through private communication in this network. Although the Lab Sites moderators encouraged

them to pose questions publically, they refrained. They may have felt embarrassment, or simply not believed that their questions would have value to others. Their motivation still seems primarily information-oriented, rather than social, as in the Teaching Forum. Public discussion of difficult issues, or inquiries that might reveal ignorance, may require a way to break down potential professional embarrassment through either strong social bonds or changed beliefs about acceptable professional ignorance and knowledge.

Access

Study of the two ETC networks, as well as reports of many other networks for teachers, strongly suggest that easy access to the computer increases use. Last year's correlational analyses of the Science Teachers' Network use showed that having a computer at home increased participation; teachers had much difficulty finding time in the day to use a computer provided at school. The Geometry group of the Lab Sites project significantly increased use after arrangements were made for all members to have computers at home. However, in neither of these ETC applications was network use necessary for teachers to carry out their jobs.

Knowledge of Basic Telecommunications Skills

For some of the Lab Sites teachers, the extra burden of learning the typing skills or the basic steps in telecommunications was too much to add to their foremost task of carrying out a new teaching approach in their classrooms. If telecommunications had been essential to carrying out the innovation, perhaps these barriers would have been overcome. In a collegial exchange network, network designers should keep in mind that learning the basic skills may be a barrier for many potential users; if they expect a high portion of those who have access to participate, training and continuing forms of help must be provided. In a common task network, where all members are expected to participate, even more resources will have to be invested to insure that each member is able to learn the basic skills and, for some, overcome discomfort with using computers generally, or with aspects of telecommunications in particular. Otherwise users will be only those who naturally feel at ease with computer-based communication.

Motivation

We and other researchers have also noted the wide variation in participation rates, and the enthusiasm with which some take up the medium, while others lose interest after a short period. For some people the activity of communicating with others in this medium may be intrinsically rewarding; for others -- the majority -- their use will depend on whether what is discussed on the network serves their particular needs.

Rates of participation in computer-conferencing have been studied extensively by EIES researchers and others who have been interested in the psychology of group decision-making. These studies suggest that computer conferences generally provide as much or more equality of participation as face-to-face groups. While this may be true when comparing conferences with face-to-face groups on some task, we would also expect that the profile of participation in either would depend greatly on the nature of the task and the roles of members of the group. In the Science Teachers' Network and the Lab Sites Network, using the network was not essential to teachers' work and use varied greatly. Possibly the only case in which planners could expect all members of group to use a network is when it is essential to carrying out a task, rather than simply an adjunct, for example in distance course delivery. These activities are medium-dependent. At the same time, the medium's reliability and effectiveness in course delivery may be a problem, and this is a subject of current research (Hiltz, 1987, and others). Conversely, applications which anticipate variability in response to the medium make sense: for example, using it for supplementary and voluntary aspects of an activity, any activity considered as "enrichment". Here the core activity is not medium-dependent but is carried out in multiple media and optional parts of the activity are carried out in computer-based conferencing.

RECOMMENDATIONS AND CONCLUSIONS

For purposes of discussion, it is convenient to divide the kind of networks we have studied into two categories which we will assume have different motivational structures: "common interest" networks, and "common task" networks. Recommendations are presented separately for these two kinds of networks, followed by some comments applying more generally.

RECOMMENDATIONS FOR COMMON INTEREST NETWORKS

The message content and teachers' interview responses for the Science Teachers' Network, survey of the MIX (EMSIE) network and report from Bank Street College show that teachers themselves have several goals in their use of a common interest network: access to specific information, especially to serve classroom teaching; engaging in discussions; and a feeling of being connected to others with similar concerns. An ideal common interest network would provide opportunities for meeting all of these. Doing so entails several design principles:

(1) Membership Criteria and Size

(a) Size: If teachers' interests are both specific and diverse, a large membership, and guests with special expertise, will maximize the probability for teachers' interests to be met. Network designers should consider membership criteria carefully, since these criteria will probably also define the kinds of

information resources that are available within the group. From our observations, the lack of interpersonal familiarity that will occur in a large network does not deter the development of public discussions, although it may decrease the quantity of private mail and alter the quality of public discussions, because more clarification will be needed by discussants who know little about each other. Still, in a network where specific information is valued, it does not seem a sensible strategy to limit membership size with the expectation that members of a small group will be able to get to know each other more quickly. In all the interest-based networks we know of, rates of participation varied widely. Members whose information interests are not met do not log in or write messages that reveal their personalities. These members will not become known by others. Thus members may not be motivated to participate enough to get to know each other unless their information needs are met. Limitation of membership size, however, might be an effective design for a common task network.

(b) Definition: The definition of membership criteria, just as in the definition of forum topics, provides the critical cues to members as to what the group is about and might do, setting some boundaries on the diversity of topics/interests that will be undertaken. Thus clearly defined membership criteria may be helpful in structuring effective communications. A group whose membership criteria are clear to members may nevertheless have diverse interests. We found a great diversity of interests within our group which was limited to high school science teachers in the 617 telephone area code. Within the interests that exist in a network membership, there needs to be a critical mass in each interest area in order for participation to develop. Thus the definition of membership criteria, and some understanding of the interest areas, is directly related to policy on membership size.

From our experience, the ideal membership size for a group of mostly unacquainted secondary science teachers would be larger than ours (which was about 70 teachers and guests); 100-200 would perhaps be a viable size. While a very large, nationwide network would also be very beneficial in meeting teacher's interests in specific kinds of information, users may suffer from message overload. In such a network, the system must be designed so that users can search easily for the messages on their specific interests.

Persons with special expertise provide an additional level of information to that of peers alone which we see as a very important resource and stimulant. Guests or moderators were present in almost every case of extended discussion that we identified. At the same time, since both of our networks included experts, we cannot say what might occur in a network defined to include only peers. The networks we surveyed were also ones in which a variety of levels of knowledge and expertize were present.

(2) Ways to Structure Discussion

The three main interests expressed by the science teachers -- specific information, discussion of issues and experiences, and a feeling of connectedness to others -- dictate, in addition to a large membership size, that the network be designed to present and structure thoughtful discussion. These structures include (a) system design features and (b) moderators.

(a) System Design Features

Topic Identification: How the major topics are labeled and organized for the user to review and select, and how, within an area, messages are organized and potentially reviewed, are the critical means by which topics are organized. Some systems use a tree structure for topics, in which major topics are broken into subtopics. Some systems also have a message "threading" feature: in the EIES, Cosy and other systems, when a message is written the author defines it as a response to a previous message, or a new one. If it is a response to another message, it is tagged with the same topic line. The reader can then review a chain of messages on that topic. Common Ground, designed to be a small system to run on a microcomputer, does not have these features and is less complicated and easier to use than some others, as a result. In Common Ground the user can review messages by "keyword," which is any word appearing in a topic line, with a similar result to message threading. It seems that in either kind of system (with or without message threading), a sense of fragmentation of topics can occur. EIES system designer Murray Turoff (1987) listed the fragmentation associated with message threading as one problem in system design. At the same time, we have found fragmentation of topics a characteristic of Common Ground output as well.

Encouraging Thoughtful Writing: We noted a range of writing styles, and examples of discussions on complex topics that entailed more reflective vs. more impulsive writing styles. System features can encourage participants to take more care in writing by making it easy for them to upload messages. The MIX system now encourages participants, through choices provided in the menu to download messages, to write responses off line and upload them later.

We cannot make specific recommendations about system design, but only note that the simplicity of Common Ground was satisfying to a number of users who had also used other systems. The direction of development of EIES is now to provide the user means to tailor their own system features (TEIES), recognizing that users with different purposes need different ways to organize exchanges (Turoff, 1987).

(b) Moderators

What moderators can do. Moderators can help organize discussion in many ways on a network, ranging from simply deleting old messages or re-sending messages that would seem of interest but haven't been answered, to extensive social facilitation -- welcoming new members, putting members with similar interests in touch with each other, and encouraging participation either explicitly or implicitly (by adding to a topic themselves). More than this, moderators may be important in the modelling of styles of communication that are most effective for the network goals. Furthermore, it may be that, the larger the network, or the more that system features fragment topics into separate streams, the more important is the moderator's role in overseeing the network. In our Common Ground networks which were small and where topics were relatively easy to follow, the moderator's help in organizing discussion was still useful. More than this, a skillful moderator can weave together a wealth of interesting information and discussion with only a few participants, as shown by the Earth Science Forum of the Science Teachers' Network. This forum included our best examples of discussion except for the Teaching Forum; discussions took place among the moderator, several guests, an ETC staff member and a few teachers.

What moderators cannot do. This forum also made it clear that no amount of skillful moderation could increase participation if interest and knowledge of a topic were not present -- there were very few earth science teachers in the Science Teachers' Network. In addition, simply exhorting people to participate was not an effective moderator style. One moderator in the Lab Sites even offered a small financial incentive to encourage people to log in, and this was also unsuccessful. In these two networks, the essential motivation for writing was clearly an interest in communicating on the given topic. A useful moderator tactic is either to make a comment simply acknowledging or thanking an author for a particular offering, or to make a substantive comment on the topic itself. Still, there is probably no one approach to be used in all contexts; moderators probably have decide what is most helpful in each different social/topical situation.

(3) Additional Information Resources in Database Form

Since a number of our science teachers reported that they enjoyed using other local networks (e.g. the University of Lowell network, and the U. Mass Physics Forum) in which lessons or other teaching materials were available for downloading, access to databases which include such materials would probably be welcomed by many teachers. Ofcourse teachers may also enjoy accessing and searching library materials. Teachers can now do this through existing library facilities; the only issue is whether some integration of these facilities within a network which also has discussion facilities would be warranted. A primitive example of such a facility is that designed by Bank

Street College, in which the Bank Street Writer is integrated with database program. Participants create their own databases, which can be altered and sent as regular messages. In this way it is possible for students to collect data under predefined categories and to share it with each other. Teachers or students may wish to select certain variables within the total data set and review the data for relations among the variables. It is also possible for teachers to send out tests for students to complete. This particular facility is designed so that specific classroom projects can be carried out and thus falls more into the category of Common Task Networks, discussed further below; but it could also possibly be an exciting adjunct facility in a common interest network which would allow teachers to design data collection and other projects which could not be carried out without a database facilty.

(5) Supplementing Telecommunications with Other Forms of Communication

Many collegial exchange networks have found it helpful to send out newsletters and to arrange for face-to-face meetings of their members. The first is helpful because members who have not logged in for a while can be updated on what is available on the network, which may interest them in logging in again. The second is helpful because meeting face-to-face allows people to learn much more about each other than is possible through network communications alone, enriching the understanding that can take place in future network communications.

RECOMMENDATIONS FOR COMMON TASK NETWORKS

(1) Understanding the Communications Needs of the Task

Whereas the purposes of a collegial exchange network are loose and open-ended, the usefulness of a computer network to a particular task depends on the nature of the task and the qualities of communications through computers. Although telecommunications offers speed and equal access by members to public communications, its disadvantages are the possibly varying times at which members will receive their messages, possible fragmentation of topics, and the ambiguity in written communications in general inherent in the lack of nonverbal cues. The many applications of computer-based communication in education now include distance course delivery, collaborative data collection and analysis efforts among geographically dispersed sites, supplementing in-person workshops for curriculum development or implementation efforts, discussions between teacher/students and guest scientists or other specialists, penpal activities between classrooms, and many kinds of classroom projects involving communications within or between schools. The reader is referred to the Bibliography for research reports on these efforts. Our own experience, conversations with Denis

Newman and others at Bank Street College, Griff Wigley of the MIX network, and Mark O'Shea at the Farleigh Dickensen University and the New Jersey Institute of Technology, indicate that (1) a network must serve real needs for communication among members or it will not be used; (2) if a task is designed to be carried out over a network, the logistical difficulties of network communications must be forseen, such as whether members can be relied upon to read their mail at the time needed.

CHOOSING APPLICATIONS

The constructive use of ambiguity in message content, an ambiguity sustained by the medium's asynchronicity, may facilitate the expression and integration of different points of view into a discussion. ETC and other research on topic development suggests that tasks needing diverse interpretations, through expansive and perhaps even playful interactions, might thrive in this medium (see Black et al., 1983; Levin, Kim & Reil, 1988; Waugh et al., 1988). As discussed above, sociological research comparing group problemsolving tasks in face-to-face groups with that in computer conferencing found wider group participation in the computer conferences (Kerr & Hiltz, 1982). How written electronic interactions can best build upon this quality needs to be explored by examining the success of different network tasks and topics. Such analyses are being made by James Levin and Naomi Miyake (see Waugh et al., 1988).

Teachers' interactions on the two ETC networks suggest that they seek a host of practical and specific information that they can apply immediately to their teaching work. At the same time, although topical interest may be the essential common ground that allows interactions to begin among unacquainted professionals, many teachers also valued social aspects of their interactions. Improvements in system design and decreases in cost of use in the future will allow telecommunications to better serve teachers' needs. The systems alone, however, provide only the medium for <u>activities</u>, whose social and task characteristics determine the nature of interactions. The design of the activities themselves, whether to support teachers' expressed needs or to bring about change in the educational system more generally, is the greater challenge. Network planners thus need to work together with teachers, staff developers and others who have experience and ideas about what activities will work best for particular goals.

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LIST OF APPENDICES

A. Common Ground, Byte Magazine, December 1985.

B. The Use of a Microcomputer-based Conferencing Network in the ETC Laboratory Sites Project, by Kathryn Stroud

C. Letters Inviting Old and New Members to the 1987 Science Teachers' Network

D. Teacher Interviews, Laboratory Sites Network

   a. Interview 1, January 1987
   b. Interview 2, July 1987

E. Teacher Interview, Science Teachers' Network, July 1987

F. Laboratory Sites Teachers, Questionnaire on Previous Microcomputer Experience

G. Science Teachers, Questionnaire on Previous Acquaintanceship with Other Members

H. A Discourse Analysis of Four Interactions on the ETC Science Teachers' Conferencing Network, by Moira Inghilleri

APPENDIX A

Common Ground, Byte Magazine, December 1985.

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COMMON GROUND

BY CHRIS HANCOCK

The user-friendliness of this microcomputer-based conferencing system derives from its easy-to-visualize functions

IN THE COURSE of putting together a computer-based conference for science teachers, my colleagues and I wound up writing a complete conferencing system that runs on a microcomputer. It's called Common Ground, and we think it's the best in its class. In this article I'll talk about the program and some of the thinking that went into its design, and I'll present some of the program's internal structures. I'll also discuss some issues to consider in running your own conference using Common Ground.

The Educational Technology Center is an organization funded by the National Institute of Education and based at the Harvard Graduate School of Education. Its mission is to study how computers and other new technologies might help improve the teaching of math, science, and computing. One problem we've been looking at is the isolation of science teachers: Many science teachers, especially in rural areas, have very limited opportunities to share ideas with colleagues or to find out what's new and interesting in their scientific fields. Computer conferencing seems to be one promising way to address the problem. We've been putting together an experimental computer-based conference for science teachers in order to see the ways it might help.

We needed our conferencing software to satisfy several requirements. First, it had to be easy to understand and use; this was our single most important criterion. At the same time, it needed to be a real conferencing system with enrolled participants, full capabilities for private messages, flexible organization of public discussions, and effective ways of searching through messages to find what you're looking for. Finally, we wanted a system that would run on a microcomputer.

School districts, like many other organizations, have modest budgets, and for most of them a large computer is out of reach. Of course, there are limitations to using a microcomputer. For the time being, at least, most micros can support only one user at a time. This imposes a pretty hard limit on the total number of participants, but the limit is not as low as one might think, provided people's schedules are varied enough. We have seen a conference with as many as 100 regular participants run comfortably on a micro. Given that one of our goals is to develop a strong conference community, more than 100 people would probably be undesirable anyway. The one-user-at-a-time limit also means that occasionally you do get a busy signal when you call, and you have to try again later. This wouldn't do for businesses where messages need to get through quickly and without fail, but for our application that isn't so crucial.

AN EASY SYSTEM TO USE

We couldn't find the system we wanted, so I wrote it. We feel that its simplicity and ease of use are a design triumph. The single most important reason for this is the spatial metaphor around which the system is structured. We picture the Common Ground system as a building with rooms in it. Every enrolled participant has a private office that no one else can get into. Private mail sent to a par-

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ticipant is delivered to that person's office. The building also has other rooms, called forums, that anyone can visit. Each forum is devoted to a particular discussion topic.

The power of the spatial metaphor is that it makes it easy to understand the state of the program ("where" you are in it) at any moment. Most interactive programs can change their states in a couple of ways: The data that is active or loaded may change (for example, you might load a new text file into a word-processor buffer) or the current mode may change (for example, in a database program you might go from record-definition mode to data-entry mode). In the Common Ground system, the idea of moving from room to room stands for a change of active data. When you are in your office, you have access to your personal mail; if you move to a public forum, you have access to the public mail there. As for modes, I have consciously worked to keep the number to a minimum. In fact, for the ordinary user there are just three modes. The main mode has just 10 commands. Then there's message-entry mode, where you type in your messages. The third mode is the text editor, which can be avoided by novices. (There are also special modes for the operator and other privileged users.) The main-mode commands are as follows:

scan: lists the messages in the current room.
read: reads messages in the current room. The scan and read commands both accept qualifiers that select messages in the room, based on date, author, topic, and whether you've read them before.
send: sends a message to any room or combination of rooms. The send command features a line editor for those who want to edit their messages before sending them.
scout: lists all forums on the system and the number of new (for you) messages in each one.
visit: lets you move from room to room.
home: takes you back to your own office.
whois: provides information about a participant or a forum.
set: lets you change your password as well as specify the width and height of your screen.
help: provides full on-line documentation.
bye: ends the session.

The short sample session shown in figure 1 gives the flavor of the system. As you can see, private and public mail is read and sent in pretty much the same way, using the read, scan, and send commands. Their effect simply depends on what room you're in and what room(s) you send messages to. This is a good example of the design principle known as orthogonality: One set of features operates independently from another set, with every possible combination having a meaning.

Orthogonality is prized by software people because it generally lets you express a lot in terms of just a few basic concepts. Sometimes, though, an orthogonal structure forces you to abandon your commonsense understanding of the application in favor of a more abstract one. This trade-off came up in the issue of groups and forums. Besides participants and forums, there is one other kind of entity to which you can address a message: a group. Groups do not correspond to rooms in the system. Instead, each group has a membership list, and any message sent to that group is distributed to the offices of all members of the group. Membership in groups is controlled; you have to ask to be enrolled in them. Groups are intended for topics that are confidential or urgent.

So groups and forums differ in two ways: Groups have restricted access, while forums have open access; and group messages are delivered to their members, while forum messages go to a room of their own. Thinking orthogonally, it's possible to imagine two other kinds of entities: forums with limited access, so that not everyone can visit them; and groups with free access, which participants can enroll in at will (perhaps using commands like subscribe and cancel, to invoke the home-delivery feature).

This time, we decided the orthogonality wasn't worth it. For one thing, it makes the solution more complicated than the problem. For almost any conceivable purpose, one of the existing options (forum or group) will do just fine. Moreover, a lot of attention devoted to access and privacy schemes would be out of place in a system intended to promote a feeling of community. The other important consideration was simplicity. Forums and groups are easy to understand: The words "forum" and "group" resonate well with the way they actually work on the system. Abstracting out the two dimensions they differ on would lose us that valuable intuitive base, unless we devoted a lot of effort and emphasis to a more extended metaphor (perhaps involving keys or secret passwords to forum rooms, which begins to seem more like an adventure game!).

Design Issues

The most important work in producing a piece of software like Common Ground is not implementing it but specifying it—designing the way it will appear to users. Furthermore, in order to decide how the program should behave, you need, in effect, to design all the activities that will take place around the program. It is vital to recognize that the software system functions as a part of a larger system of human and technical interactions. As the principle of top-down design implies, the first task is to design that larger system and then to proceed down to the computer program itself. Design decisions at the top level will have implications for the design of the actual program.

In principle, this is true for any program. It is crucial in the case of a computer conferencing program for two reasons. First, computer conferencing consists of more than just the running of a computer program. Second, because computer conferencing is in its infancy, there are plenty of open questions concerning how a con-

ference should be run. These are also the reasons why our eventual goal is to produce a package that includes, in addition to software, an extensive guide to running an educational (or other) computer-based conference.

We began our top-level design work by looking at the different kinds of problems that computer conferences can run into and thinking about ways to solve them. One of our conclusions was that a successful computer conference must have people working in several different roles, which are described in the following sections. The existence of these roles has in turn affected how the software is designed. Naturally, the importance of these roles varies with the type of conference. In a very informal conference,

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COMMON GROUND version 1.0

   — ETC Science Teachers' Network Pilot —

codename: fred
password:
fred logged in at 3:17 PM July 14, 1985

_fred > mail

  message 414 from chris filed July 14, 1985 9:17 AM
    re: just saying hi
  message 400 from donh filed July 12, 1985 12:28 PM
    re: how about an AP physics forum
* message 325 from cju filed June 22, 1985 7:25 PM
    re: invitation

_fred > read new

msg no. 400 filed 12:28 PM July 12, 1985
from donh
to bram fred ellenk
re: how about an AP physics forum
Hi folks. I'm thinking about proposing that we set up
a new forum for discussing problems and ideas for
teaching AP physics. One thing the forum could
work toward would be a series of tried and true
lab experiments. I know you have taught the course.
Would any of you be interested in such a forum? Do
you know who else would be?
OK to release? n
not released.

msg no. 414 filed 9:17 AM July 14, 1985
from chris
to fred
re: just saying hi
Hi Fred, how have you been lately? I
thought of you yesterday when I was
buying vegetables. Well, see you
later. /chris
OK to release? y
message 414 released

_fred > send
  to: chris
  re: hi
enter text, terminated by =
That's amazing. I thought of you yesterday
when I was feeding my parking meter. I wonder
if it was at the same moment? /F
=
send, review, edit, abort (s/r/e/a): s

_fred > scout
        forum    # new messages
       whales     0
           nb     0
       system     0
         soft     6
          nsg    11
        halley    2
         mott     2

_fred > visit halley

_halley > scan
  message 357 from renee filed July 5, 1985 1:02 PM
    re: susan's radio idea
  message 330 from chris filed June 23, 1985 9:33 AM
    re: telescopes
>message 319 from chris filed June 21, 1985 11:41 AM
    re: went to the lecture
  message 315 from renee filed June 20, 1985 7:14 PM
    re: comet halley
  message 291 from sburt filed June 18, 1985 11:18 PM
    re: I need telescope advice
  message 290 from kim filed June 18, 1985 11:14 PM
^O...
_halley > read 330

msg no. 330 filed 9:33 AM June 23, 1985
from chris
to sburt halley
re: telescopes
Hi Susan! I've just heard that if you
want to get a good view of Halley's
comet you should get a telescope with
a short focal length. This is because
the comet will be dispersed over the sky
...several times bigger than the moon.
/chris

_halley > bye
bye
%%%%
```

Figure 1: *A sample session on Common Ground. The user reads three private mail messages, sends a private mail message, checks for any new activity in the forums, visits the* halley *forum, and reads a message there.*

Many would-be participants never get over the initial hump of learning to use a conferencing system.

with computer-literate participants, all the jobs can easily be done by one person.

Users' Technical Problems

Many would-be participants never get over the initial hump of learning to use a conferencing system. Connecting one's modem, figuring out how to use the communications package, setting communication parameters, dialing up the system, logging in, and navigating the conferencing system itself—every one of these is difficult the first (and second) time and is an opportunity to get snagged. A few technical problems, compounded with bad documentation and a general distrust of computers on the part of the user, have put a quick end to many a novice's conferencing career.

Our response to this was twofold. First, we decided that if the conference participants are not experienced with computers, then it is vital for the conference to have a technical support person who helps novice users with the conferencing system and with their own communications equipment and software (a hand-holding session is often the best way to get over the initial hump). The support person should be available whenever users have technical problems or questions.

Second, we have worked very hard to make the system as easy to understand and use as possible. We have kept the number of commands to a minimum. The metaphor of forum rooms and private offices helps tremendously because it makes it easy to picture what's going on when you're using the system. It's also worth noting that in trying to make the system simple I chose a command-driven structure rather than a menu-driven one, and that the commands are entire words, not single letters (actually, the words can be abbreviated, but we don't emphasize that fact to novices). It is generally assumed that menus with one-letter options are the most user-friendly way for an interactive program to work. However, this is really the case only when the program itself is the user's only resource for help. It is not the case when (1) the program is meant to be used often, at 1200 or 300 bits per second, and (2) there is someone to teach the user how to work the system. Under those conditions, commands are better because you don't have to sit through the menu display every time, and entire words are better because people who aren't computer experts relate better to words than to codes. This is a good example of how considering the human activities in the conference has affected the design of the software.

Reluctance to Participate

Participants who do learn how to use the system often don't make any contribution to the discussion. They feel uncomfortable with the medium. After all, it can be scary to put your opinions and questions out in public view, when you can't even see who's reading your message and how they're responding to it. It's a disconcerting experience to write a message and get no acknowledgment back. What did people think? Was the message irrelevant? Was it dumb?

This, too, has affected our software design. First, we recognize the value of small scale in a conference. A huge enrollment contributes strongly to the anonymous feeling that makes people reluctant to participate. This is one of the main reasons why we were happy to run our conference on a microcomputer. It is also why Common Ground is not designed as an open-access system. One of the roles we envision in the running of a computer conference is the membership coordinator. This person decides who gets to participate in the conference and keeps in touch with members about whatever administrative issues arise. The membership coordinator is also the chief steward (participants can be given stewarding privileges, which enable them to add participants to the system, create and delete forums and groups, change people's passwords, and so on).

In addition to limiting scale, we have also consciously limited the function of the conferencing system: it is meant to be used for having discussions, not for exchanging computer programs, keeping databases, or archiving old messages. These are functions that would dilute the sense of community that helps to make good discussion possible and would also make the system more complicated to use.

Finally, the program expects every forum to have a moderator. Unlike the other roles listed here, moderators for the various discussions will normally be drawn from the general conference membership. Although the technique of moderating a computer-based conference is not yet well understood, writers on computer conferencing agree that it is very important to have a moderator who keeps discussions on track, elicits comments from participants, and ensures that everyone feels rewarded for their participation. In the Common Ground system, moderator privileges include moving messages in and out of the forum and editing the topic headers of messages in the forum so that they more clearly reflect message content.

Content

The bottom line is this: If the content on the network isn't interesting and important to the participants, they won't participate. Yes, just communicating by computer is fun, and for some of us that's enough to hold our interest. But for most people, after the novelty has worn off, computer conferencing has to compete with other daily pressures. If they don't perceive the experience as worthwhile, they'll

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leave. In some cases this means that a computer conference isn't appropriate. Many computer-based conferences have failed because they simply didn't fulfill any pressing need for the participants. When a computer-based conference is appropriate, somebody needs to be concerned with maintaining worthwhile content. The "content coordinator" keeps watch over the discussions, arranges for special guests or events on the system, and in general tries to promote interesting and valuable discussion content in the system. This person is also the system's chief moderator.

After all this talk about human roles, it's still true that you can't have a computer conference if your computer isn't working. That's why a conference also needs a system operator. The sysop takes the system up and down, worries about hardware, and periodically runs file-maintenance routines. The Common Ground program starts up in operator mode. The operator can start a local Common Ground session at the console or put the program in wait mode (waiting for a call to come in). The operator can control monitoring of calls at the screen or at the printer. In addition, whenever a call is in progress the operator can "butt in"—that is, make the console share the remote user's input and output. This is intended mainly as a way to help novice users. It lets the operator type in commands for users, right before their eyes, and explain what's happening step by step.

Principal Data Structures

I developed Common Ground using Turbo Pascal on a DEC Rainbow Plus with a hard disk. The complete program is about 5000 lines long. The system's data is kept in three random-access files: the recipients file, the message directory, and the message-body file.

Each component of the recipients file is a Pascal record containing complete information about a recipient ("recipient" is the general term I use to mean a person, forum, or group—anything you can send a message to), including its full name and a list of its current message numbers, or, in the case of a group, its membership list. Every time a new recipient is added to the system, a new record is appended to the file. As you can see in figure 2, a recipient's position in the file (its component number) is used throughout the program to stand for that recipient.

The message directory contains all the information about messages except for their actual content. Each component is a record that holds the

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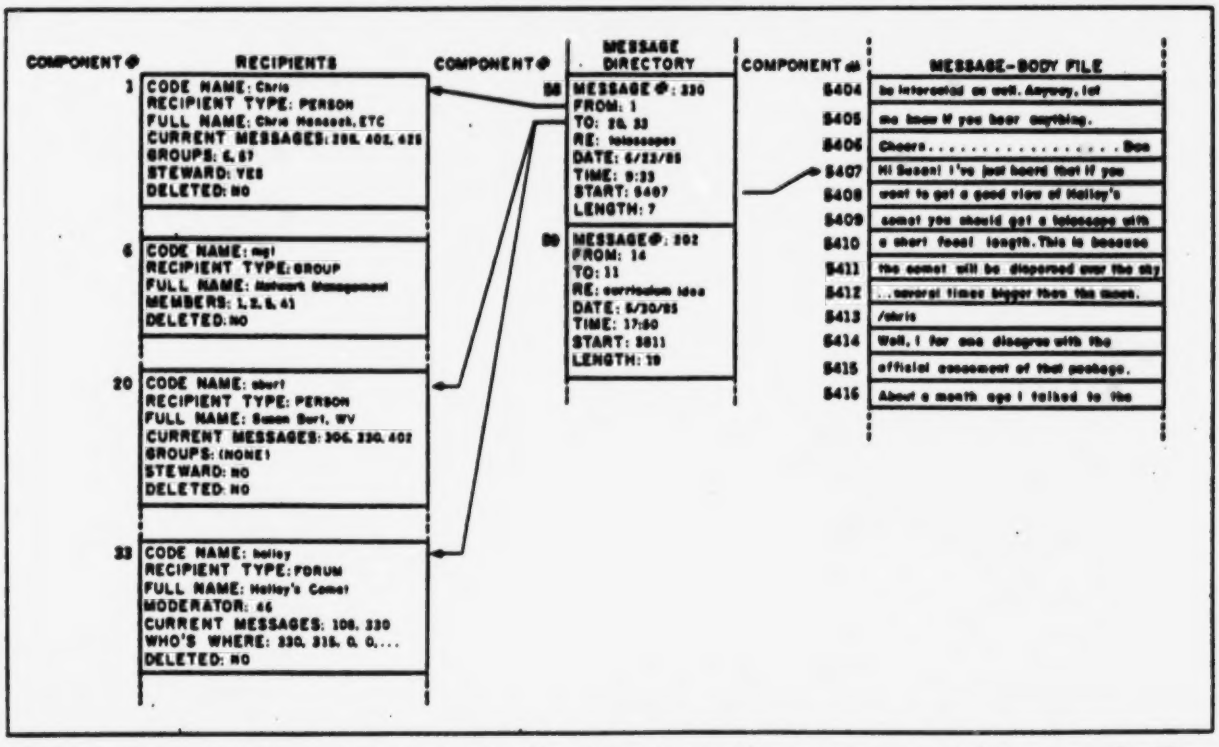

Figure 2: *An example of Common Ground's three data files, showing how the different components are linked to one another. The* WHO'S WHERE *entry in the* halley *forum is a list showing how far recipients have read. For example, the* 330 *in the first position indicates that recipient* 1 *has read up to message* 330. *The* 315 *in the second position indicates that recipient* 2 *has read up to message* 315.

While the limit of one user at a time is not a serious one, it would obviously be nice to overcome it.

message's author, addressees, topic header, time and date of filing, and a pointer to the location in the message-body file where the text of the message can be found. Since messages are periodically purged and message numbers keep increasing throughout the life of the system, the entry for a message can't be stored in the component with the same number. Instead, the component number for a message entry is computed by a hashing function. Hashing collisions are resolved by the quadratic probe technique (if the component you want is full, look at the next one; if that's full, look at the one four positions away; if that's full too, look nine positions away, and so on).

The message-body file is a random-access file of strings containing the actual text of messages. It's a file of strings because you can't have random access to an ordinary text file; the components all have to be the same size. Because of the limit on the number of components in a random-access Pascal file (64,000), the message-body file is actually implemented as a sequence of files. Every time a message is sent, its text is appended to this file.

Let's look more closely at what happens when a message is sent. Suppose that user chris sends a message addressed to sburt (a person) and halley (a forum), as shown in the sample session in figure 1. Here's what happens:

- The body of the message is appended to the message-body file, and the message is assigned the next available number (330 in this example).
- 330 hashes to component 58 of the message directory, so the information about this message, including where its text can be found in the message-body file, is stored there.
- The number 330 is appended to the mail lists for sburt and halley in the recipients file.

When sburt logs in and types read new in her office, one of the messages she will see will be number 330. After displaying the message, Common Ground will ask her if it's okay to release it. If she says yes, the number 330 will be removed from her current message list; if not, it will be flagged as read (by changing it to a −330) so that it won't be displayed the next time she enters read new.

As time goes by, the system begins to fill up. Some of the recipients have been deleted by stewards and are using up space in the recipient file. Some messages are "dead," having been released from every room they were sent to. The purging process goes like this:

- The unused slots in the recipient file are freed for future use. This doesn't mean that any records are moved around in the recipients file. Instead, all references to the numbers of deleted recipients are changed. For example, suppose chris was deleted from the system and a new person, freida, was added in position 1. If message 330 were still around, it would now display as though it had been sent by freida. To avoid this, the purging process will change message 330's author from 1 to 0, which will display as -deleted-.
- A binary search tree of all active message numbers is built in main memory, containing all message numbers found in any active-message list in the recipients file.
- The program scans through the message directory, zeroing out the message numbers of messages that are no longer active and recording, in the active-message tree, the message-body file pointers for all active messages.
- The message-body file is collapsed, using the pointer information in the active-message tree. The text of active messages is moved back over the space occupied by inactive message text.
- The header file is rehashed because the entries for active messages might now be out of position due to collisions with messages that are no longer active.

What You Need

Common Ground will run on a DEC Rainbow (running MS-DOS version 2.11 or later) or an IBM Personal Computer or compatible. For a big conference and optimal response time, you should have a hard disk with between 1 and 10 megabytes devoted to the conference, but you can also have a decent conference with a pair of floppy-disk drives. A third floppy-disk drive will increase the maximum number of active messages from approximately 300 to 500. You'll also need an auto-answer modem that can run at 300 bits per second, 1200 bps, or both. The original Common Ground system was developed with a Multi-Tech 300/1200 modem, but it will also work with a Hayes 1200 and most compatible modems. [*Editor's note: The object code for Common Ground is available for downloading from* BYTE*net Listings at* (617) 861-9764.]

Future Developments

While the limit of one user at a time is not a serious one for our present purposes, it would obviously be nice to overcome it. If and when multitasking MS-DOS and Turbo Pascal become available, it will be possible to have more than one user logged in at a time. However, the most exciting next step for the system—and one that doesn't have to wait for new technology—is the interconnection of Common Ground systems. This will allow participants on one system to send messages to participants on other systems, as users of FidoNet are currently able to do. It will also allow a joint forum discussion to be shared by two or more nodes. The actual message transfers will normally happen automatically at night, when phone rates are lower. ■

APPENDIX B

The Use of a Microcomputer-based Conferencing Network in the ETC Laboratory Sites Project

Kathryn Stroud

I. CONTEXT OF THE NETWORK

The major goal of the Lab Sites computer-conferencing effort was to facilitate communication among members of the Lab Sites Project. The computer conference was provided to supplement face-to-face communications, and the research aimed to describe how project members would use the medium. Within this, Network staff were especially interested in the kinds of discussions that would occur, and in whether teachers would use the Network for reflective discussion of their subject and practice, as well as for more practical matters.

An evaluation of the Lab Sites computer conference required that we understand communications in general among project members, that we interpret the role of computer-based communications within forms of all communication. Therefore we needed to characterize group communication both on and off the Network. To achieve the later goal, the following descriptions attempt to characterize each group in terms of their task and the content and direction of communication off the Network.

A. Context of the Geometry Innovation

The geometry innovation was a year-long attempt to improve the teaching and learning of geometry through integration of inductive reasoning into the traditional geometry curriculum. The project was based on the Geometric Supposer software which was designed to facilitate this type of thinking. The project provided teacher support for this change in approach. While the science group sought to overcome technological barriers, the geometry group faced the challenge of assimilating this new form of teaching into existing curriculum. Although group members differed in a number of respects, including school setting and student ability, they shared the common experience of adjusting to change in approach to teaching geometry. In addition, most had some previous experience with microcomputers.

The struggles associated with the adjustment of teaching practice were reflected in monthly meetings soon after the beginning of the project. Meeting minutes reveal that after an initial period of emphasis on logistical concerns, the group began to share their experiences and reactions to the innovation. The majority of meetings seem rich with discussion of how use of the Geometric Supposer challenges and uncovers a variety of approaches to teaching and learning geometry.

The advisor structured meetings to encourage teachers to share experiences. He began with an agenda and list of issues for discussion, and using these as a catalyst, attempted to facilitate a "round table" discussion among teachers. As a result, teachers looked to both the advisor and their colleagues for support throughout the implementation process. Teachers participated in discussions and soon began to take shared responsibility to learning together as an intellectual community. As hoped, a "round table" exchange evolved, where each member of the group communicated with others by offering and listening to contributions. The advisor became both colleague and leader by acting to keep things on target and encouraging discussion, as well as sharing his experiences in teaching with the Geometric Supposer.

His style was one of running the meetings to foster use of the inductive approach he wanted them to use with students. In summary, both the nature of the innovation and structure of meetings may have encouraged teachers to pay less attention to their differing backgrounds and to develop the support community necessary to acquire comfort and expertise with such an innovation.

The common experience of using a dramatically new form of teaching may have led to the need for support from others sharing their experience -- making discussions between teachers a natural development. Together with advisor visits to schools, the need for collegial support was met by the interactions among the teachers.

B. Context of the Science Innovation

The focus of the science innovation was to teach certain science concepts and distinctions using microcomputer-based labs (MBL). This year's work looked closely at the implementation of a unit on heat and temperature. A key element in this application was the teacher's ability to recognize and respond to "rich moments" where students can challenge and rethink their understanding of a concept.

The implementation of the heat and temperature innovation differed from the others in a number of respects. While the geometry and programming innovations took a school year or a semester to complete, respectively, the heat and temperature unit took approximately two weeks. In addition, the teachers involved in the project taught a variety of science subjects at different levels; making it necessary to integrate the unit at different points in the year. According to the advisor, for many members of this group there was an "out of sight, out of mind" attitude, where teachers did not think about the unit after its completion, and were not motivated to communicate with other teachers using the unit at a different time. Added to this were differences between the teachers in their approach to science and science teaching. While some teachers were trained mainly in the teaching of science, others with additional training in the sciences combined this with their own continued explorations in science. Furthermore, this group was the least familiar with computers. In fact, a number of teachers had never turned on a computer. All of these factors contributed to the diversity of the group, which in turn was reflected in the diversity of their application and discussions of the heat and temperature unit.

The project began with a barrage of difficulties with the MBL equipment. Combined with the computer naivete of most of the teachers, this made the technology doubly frustrating and a major hurdle for the teachers to overcome. The advisor of this group was an invaluable resource for these teachers, both at school and at meetings, at this point and throughout the year, as they attempted to resolve trouble with equipment and gain comfort with computers.

This preoccupation with the technology itself as opposed to the issues surrounding its implementation was reflected in monthly group meetings in which the technology was an intimidating focus for most of the group, and where the advisor served as a resource to relieve this anxiety. Meeting minutes show that the topics at meetings were generally of a technical or logistical nature, with very few spontaneous discussions by teachers of the more abstract issues of teaching and learning which underlie the integration of the unit. It seems that concern with the technology itself needed to be eliminated before teachers could feel comfortable moving toward more abstract questions -- something which may have been particularly difficult for teachers new to computers and with fragile peripheral equipment. The structure of communication at meetings was such that the advisor served as an expert colleague and fountain of encouragement from which teachers drew "free advice", rather than a "round table" discussion between all participants with the advisor serving as facilitator.

In addition to their general naivete about the technology itself, the fact that the teachers were teaching the unit at different times, had different interests, and different levels of mastery of the technology, may also have contributed to the observed minimal need for communication between teachers, both about the technology and the issues surrounding its implementation.

Attempts were made by Lab Sites staff to move the topic away from technology and toward the more abstract issues of teaching and learning with MBL, and from a focus on communication between the advisor and the teachers toward discussions amongst the teachers. Although such attempts had an initial influence, the group soon returned to their original discussion format. It is interesting to note that for the most part, the teachers who became involved in discussions of more abstract issues, either spontaneously or when prompted, were the teachers who were more comfortable with technology at the beginning of the project, and who felt free to focus on issues, rather than on the technology itself.

In summary, the science group can be characterized as diverse in interests, backgrounds, and teaching schedules. Combined with an attention to the technology itself, this led to a group whose members had very little to say to each other at meetings regarding teaching with technology, but which did have a great deal to gain from tapping their best resource -- an advisor who filled their need for support.

C. Context of the Programming Innovation

The programming innovation was a semester-long attempt to integrate the ETC-developed programming Metacourse into traditional introductory courses in BASIC. The central goal of this process was to improve students' understanding of BASIC and their ability to write programs. In comparison to the science and geometry innovations, which faced technological obstacles and fundamental changes in teaching method, respectively, the implementation of the Metacourse went fairly smoothly. Although the programming teachers had very different classroom situations, they all shared a comfort with this

use of the technology, and with the content and process of teaching an introductory BASIC course. This familiarity made the integration of the Metacourse lessons a fairly easy adaption. For these teachers, demands came not from the technology or the challenges to teaching presented by an innovation, but from understanding and following the implementation details that were associated with the evaluation being made of the Metacourse. This included struggling with a detailed script and lesson plan designed by someone else, and utilizing the Metacourse with various levels of student ability. According to the advisor, the Metacourse was designed to be like a vitamin shot, but for some it turned out to be much more when attempting to integrate the unit into teaching style and curriculum. The research interests of the programming advisor and staff, together with the teachers' concern with the same issues, led the group to focus primarily on research concerns, with consideration of teaching issues as an offshoot.

The attention to research was apparent at group meetings where discussions developed under a research "umbrella". As in the geometry group, the programming research group structured meetings with an agenda and issues identified for discussion. Meetings were organized with attention to the research, with teacher reflection on teaching process resulting from this concentration. Topics included distribution of materials, refinement of classroom data collection methods, and gathering teacher feedback in order to sculpt the Metacourse. Meeting minutes show that this tended to generate a meeting pattern where the researchers went around the room asking teachers to give impressions of the Metacourse units. Rarely did teachers have self-generated discussions amongst themselves. A "round table" format of discussion therefore did not characterize this group, rather any discussion between teachers regarding teaching issues seemed to be a result of advisor-initiated exchange on the overriding research agenda. While the advisors of the science and programming groups acted as both colleague and leader, the teachers and researchers in the programming group served as resources to one another, with the advisor serving as an intellectual linker and the teachers acting as research advisors.

In comparison to the geometry group which required strong collegial support as they adapted teaching practice, and the science group which demanded a great deal of technical assistance, the programming group faced neither of these challenges. Their need for support was met by frequent visits to schools and meetings which addressed teacher and researcher concerns with the research agenda.

II. DEVELOPMENT OF THE NETWORK

The Lab Sites Network was implemented in order to provide an additional channel of communication among Lab Sites participants. It was hoped that communication would include reflections of teaching practice and that the Network would serve to unify teachers during periods when they were unable to meet face-to-face. A number of efforts were made to facilitate teachers' logging-in to the Network and moving toward this type of discussion. These included group and individual training, provision of access to equipment, on-line biographies, and advisor attempts to encourage Network participation both on and off the Network.

A. **Training**

Training efforts began at the June 30-31, 1986, ETC conference called "Teaching with Technology Through Guided Exploration". This two-day workshop attempted to give Lab Sites participants an introduction to the Lab Sites effort. On the first day a member of the Network staff delivered a 45-minute presentation exploring the rationale and design of the Common Ground software and its potential to connect Lab Sites participants. The second day of the conference training began with a demonstration of the conferencing system and an overview of telecommunications technology. Following this the teachers were divided into groups and worked at computer stations to log-in and negotiate Common Ground using CommWorks communications software. Each member of a group logged-in and used one or two commands while the others observed. In this way teachers either used or observed each Common Ground command in use. Teachers left this session with a Common Ground manual and a pamphlet prepared by Network staff to aide teachers in using CommWorks to log-in to the Network.

To prepare for a December 5th meeting of the Lab Sites participants, Network staff planned to present more advanced uses of Common Ground, as well as procedures for uploading and downloading using CommWorks. It then became apparent from conversations with teachers that many had not reached this stage of use, and would be more comfortable with a review of this basic log-in process and commands. In response to this request, the demonstration went over these procedures as well as introduced using the CommWorks editor for composing and sending messages. Network staff also provided teachers with a list of local electronic bulletin boards in order to excite participants about the potential of telecommunications for both personal and work related tasks.

In addition to group instruction, a Network staff member visited each school during the fall to provide individualized and more intensive training. This was designed as hands-on individual or pair sessions where teachers mastered logging-in to and using Common Ground. Teacher interviews show that teachers preferred this type of training to group sessions, and would have liked to have mastered telecommunications prior to beginning to learn and integrate a teaching innovation in the classroom.

During October a half-day training session took place at Willis* High School. At this time their system was set-up in the science supply closet where a teacher had used it the previous year for another network. The session began with the trainer and the liaison setting-up the equipment and configuring the software to work with the school's phone system. After the system was set-up teachers came alone or in pairs, and practiced logging-in to the system and using Common Ground. Following this session the liaison assisted the teachers in learning how to use AppleWorks in combination with CommWorks in order to upload and download files.

The teachers at Culver High School were also trained during October. The system was up and running in the Teacher Resource Room and throughout the morning teachers came alone or in pairs to learn to log-in and use Common Ground. Attempts to provide additional training in uploading and downloading techniques met an obstacle; the inservice day the liaison thought was necessary in order for all teachers to participate was not available.

Training at Norville High School also took place during October. After a few struggles getting through the phone system in the library computer lab, all but two teachers were trained to log-in and use Common Ground. In response to liaison requests for additional training and for efforts to excite teachers about telecommunications, Network staff sent an invitation offering two mornings of training where teachers could seek assistance with any area of telecommunications; including logging-in to Common Ground, uploading and downloading, using other networks, and setting-up equipment. As many teachers were confronting busy schedules and had limited access to the computer lab, only one teacher was able to attend during the two-day period.

At Waynesboro High School, the trainer assisted in setting-up equipment in the Adult Education Office. Following this, all but one teacher was trained to log-in and negotiate the Network. Training in this setting was modified in order to familiarize inexperienced teachers with basic computer operation. As in Norville, a second series of training sessions was advertised through invitation and a reminder. The liaison also worked with teachers to schedule a convenient time to take part in this training. As a result, all but one teacher came to a second session during March where they practiced logging-in to both the Lab Sites Network and other local bulletin boards.

At Belton High School training began with the location of a computer which could be relocated from the science lab and used for telecommunications. Once the computer was in place in the teacher's office, all but one participant worked individually to log-in and negotiate Common Ground. In response to a teacher's request to learn uploading and downloading, a second training session was given to two teachers during March.

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*The school names used here are the pseudonyms adopted by the Lab Sites Project.

B. **Access**

In order to simplify training and learning among teachers, the Network staff suggested the Lab Sites participants use Hayes modems and CommWorks communications software. Following this suggestion, ETC received a donation of Apple modems from Apple Computer Company. As a result, each school had one or two modems for use with CommWorks. In addition, three of the schools were provided with Hewlett Packard portable computers. Network staff prepared a one-page guide for using this computer and recommended that liaisons develop a rotation schedule so each teacher would have the opportunity to use the system once a week. Such a schedule never formally evolved. Additional equipment was also provided to the Geometry teachers in early February in order to provide each member with home access.

Overall, teacher's busy schedules, together with access difficulties, combined to make it a strain for teachers to even log-in to the Network, let alone think through and write about their teaching practice. Advisors and liaisons proposed that teachers do not have time at school to reflect on teaching; rather they concentrate on matters at hand, and leave this type of thinking for after school. This suggests that home access is ideal for a computer conference which attempts to encourage reflective writing.

Teachers developed different ways of approaching these difficulties. At Belton High School, teachers had students log-in and print-out their messages. One teacher at Willis assisted another by scanning her mail and informing her if she received any messages.

At Waynesboro, until May when a phone line was installed in the computer lab, teachers had to obtain a key to the Adult Education Office and connect the system. According to teacher interviews, this procedure of seeing if the office was free, getting the key, and plugging in the equipment, was often too much to fit into an already busy day.

After an initial period of searching for and setting-up equipment during the Fall, a permanent station was arranged at Belton High School in the computer lab. Although this location was fairly central for teachers, meeting minutes and interviews indicate that the room was not always available, and that teachers had to adjust their Network use after finding the Network phone line busy between 2 and 3PM.

At Norville, access was a problem in a number of respects. First, the location of the computer lab was inconvenient for many teachers. It was also difficult for teachers to use the equipment while there was a class in session or while students were using it to access other networks. Finally, Norville teachers were cut-off from the Network during March when the town of Norville installed a phone system which did not allow telecommunications.

After an initial period in the science supply closet at Willis, the system was moved into the programming teacher's room. Even though this teacher welcomed teachers in her classroom to use the system, interviews show that teachers were hesitant to use the system while a class was in session or when they thought they were intruding on the teacher.

At Culver, the system remained in the Teacher Resource Room throughout the year. According to teacher interviews, finding time to log-in was a major obstacle for most teachers, and because of the large size of the school, access to the equipment was a problem for some.

C. Moderation, Forums, and Biographies

1. Moderation

Network and Lab Sites staff decided that the advisors of the groups should assume the same role on the Network through their moderation efforts. As in face-to-face meetings, two advisor/moderator would serve to facilitate participation by encouraging teachers to log-in and actively participate. Throughout the year, each advisor developed individual styles of moderation for accomplishing this goal. While the science advisor directly requested forum participation and asked questions regarding teaching with MBL, the geometry advisor was somewhat less direct, and tended to structure his messages to prompt teacher interest and response.

2. Forums

Once the Network was up and running, it became necessary to establish discussion areas, called "forums" in Common Ground. As a result, Network staff began a forum for each group, as well as a forum for liaisons, biographies (BIOG), general notices (NOTICES), and for technical questions (TECHNOTE). In addition, at the request of the programming group, a forum was added for the group to exchange programming exercises.

3. Biographies

In order to get teachers comfortable with logging-in to the system and using Common Ground, Network staff introduced the idea of online teacher biographies. During the initial meeting of the Lab Sites participants, teachers were asked to submit a biography to the BIOG forum. To assist them in this process, Network staff wrote instructions on the procedure and offered on-site training for teachers who requested it. As a result, 15 biographies were submitted over a two month period.

D. Advisor Efforts to Promote Network Use

Liaisons and advisors began by thinking about project goals and how the Network might best facilitate them. As the year went on it became apparent that poor access to equipment and time constraints were playing a key role in limiting teacher participation. In planning the Network it was assumed that once teachers began to use the Network they would become self-motivated to log-in and communicate with colleagues. Advisors observed, however, that as teachers saw their colleagues and advisors fairly frequently at face-to-face meetings, the additional opportunity for collegial exchange via the Network may not have been sufficient to motivate teachers to log-in and participate. Interviews and meeting minutes show that without a great deal to gain from logging-in, many teachers saw no purpose from using the Network. In consideration of this, advisors and liaisons suggested that in addition to encouraging use of the Network at meetings, more structured activities, such as group projects and log-in requirements, might serve to motivate teachers to log-in. Although these particular ideas were never implemented, the advisor of the science group attempted to structure participation through requiring Network response to a memo distributed at a meeting. The programming group suggested the exercises forum, as well as the Network "question of the week" that would be submitted on Monday for response by Friday.

Other efforts recommended by advisors and liaisons to motivate teachers to log-in, included having a "lighter side" of the Network, where in addition to discussion of teaching practice, there would be a forum devoted to "the joke of the week" or "favorite recipes". Although the "lighter side" idea was never tried, Network staff did attempt to stimulate interest in telecommunications by advertising local bulletin boards and encouraging teachers to log-in. Teachers were provided with a list of these services and encouraged to sample them during training or on their own time. In addition, teachers were given registration materials, documentation, training, and one hour of free time on the VU/TEXT information service, which provides an up-to-date database of many U.S. newspapers.

III. USE OF THE NETWORK

A. Overview

A review of the log-files, record of forum messages, and member interviews, reveals that the Network was used mainly in two ways: as a private conferencing system for individual exchanges between advisors and teachers, and as a bulletin board for Lab Sites advisors to publicly report information such as meeting minutes and summaries of school visits, and as a private conferencing system for individual exchanges between teachers and advisors. Teachers utilized the Network as an information source through this correspondence with advisors and by reading all messages in both private mail and public forums.

Of the 21 teachers participating in the project, 17 logged-in to the Network. Each of the seven geometry and seven science teachers logged-in and averaged 1.5 log-ins per week with a slight increase after mid-February. Within the programming group, on the other hand, only three of the seven teachers logged-in, and the group drastically reduced their use after a month.

The advisors of the science and geometry groups logged-in on an almost daily basis, and in addition to reporting in forums, used their individual style to introduce discussion topics and encourage teachers to participate in public reflections on their teaching practice.

Teachers' Network participation consisted mainly of communicating with advisors in private mail and reading throughout the Network. Their regular logging-in, however, at a rate of more than once a week, suggests the Network did have some value to them. Teachers wrote an average of one private message every two log-ins. In contrast, only one public message was sent every twenty sessions; yielding an average of one public message for every ten private messages. Each of the seven teachers in the geometry and science groups wrote at lease one message in private mail, with eight teachers writing more than ten messages. On the other hand, only seven teachers wrote public messages, with only two writing more than one. Observations show that the few public messages written by teachers attempted to initiate or contribute to discussions of teaching practice, rather than seek information of a more logistical or technical nature. According to teacher interviews, private messages were used mainly to respond to advisor questions (that appeared in forums or private mail) or to gather information from advisors. However, private exchanges between teachers did include some reflection on teaching practice.

B. The Geometry Group

The geometry teachers used the Network primarily for private mail exchanges with the advisor. There was a small amount of public participation by teachers, and communication with each other in either public or private mail.

The advisor of the group logged-in daily and was by far the most active participant in both public and private mail. Within the public mail (geometry forum) the advisor wrote lengthy messages to report meeting agendas, introduce issues, and summarize school visits. As moderator of the forum, he attempted to encourage public discussion directly by asking for responses to issues he raised in messages, and indirectly by developing his messages to inspire teacher interest and comments. For example, in the following message he attempts to gather teacher solutions to a problem:

Mike gave Steve a problem to use in his presentation to the Mathematics Department. I liked the problem and send it along for your info.
Draw an acute scalene triangle. Draw the median from vertex A (it will be AD). In tri. ADB, draw median DE; in tri. ACD draw median DF. Make as many observations and conjectures about the figure as you can.
Might be fun to send your solutions over Common Ground using whatever shorthand you can devise.

The machine log-files reveal that the geometry teachers logged-in a total of 252 times from January through June, averaging 36 times each. Specifically, almost all teacher messages were written after February 7, when they had access to a modem at home. Teachers sent an average of 13 private messages, with one teacher sending only 2 and another writing 44. There was a slight increase in the number of private messages sent during April and May, to yield an average during this time of 16. While there were a few exchanges between teachers in private mail, with a slight increase after March, the majority of private exchanges were between advisors and teachers. Although teachers were more active in private mail than in the forum, the advisor was still the most energetic participant. Interviews with teachers reveal that both teachers and advisors initiated these private discussions, and that exchanges included discussions of specific topics introduced at face-to-face meetings or online, such as suggested problems, as well as discussions of more abstract issues involving reflection on teaching practice. Interviews also show that private exchanges between teachers generally addressed issues surrounding teaching with the Geometric Supposer. The following example demonstrates the nature of private exchange between the advisor and teachers. The message was forwarded to the forum from the advisor's private mail for comment by other teachers.

I am forwarding Tom's message to the forum because it addresses the grading problems that Evan and Barbara noted earlier. I'm doing this without Tom's permission hoping he doesn't mind.

Please send your remarks to the forum for debate/discussion. This issue is a very real problem that I have experienced also.

Bill, glad to have you back although I'm sure you would prefer the beautiful weather minus the smog of southern Calf. I'm finishing congruence; kids have just done 2 lab sheets. One on discovering the theorems about isosceles triangles and converse. The second sheet was the sheet I originally numbered 14 based on isosceles triangle theorems. They proved their conjectures for their homework. All went well and they are currently doing some proofs involving s,s,s; a,s,a; h,l, etc and cpctc. We will conclude all shortly after vacation; then back to some algebra and eventually we will deal with specific quadrilaterals. I am still having some un certainties about grading vs. not grading the lab papers. I tend not to grade all of them; some I judge are better for grading purposes as they have enough questions etc. so that everyone doesn't get every

question correct. Most students accept that some are graded and some are not; I still have the same problem as Willis in that the lab paper grades are generally higher than the test grades; but I think that this is the nature of this work. Obviously I would like to come up with some way of weighing the lab grades and the test grades differently. I'm still working on it. Keep surfing!!!!!

The first forum entry by a geometry teacher was on the 7th of March. Following this entry, four of the seven teachers participating in the project wrote public messages, with only one teacher making more than one entry.

Even though there were only a few teacher contributions to the forum, it is interesting to note the variation in the topic and purpose of messages. Specifically, teachers responded to the advisor, introduced issues, asked questions, and made statements regarding teaching with the Geometric Supposer.

The following messages show teachers exploring issues surrounding teaching with the Geometric Supposer.

1) Despite the amount of school work I had in front of me, I indulged in an exploration of Tom's problem on medians. In best Supposer manner, I applied the repeat key three times and got a parallelogram each time. I certainly have my conjecture but no idea for a proof. All I can come up with are triangles with equal area, no help at all when one is in need of congruence. Unlike angle bisectors or perpendicular bisectors, medians seem to have no neat properties going for them. Any thoughts?

2) Last week I tried Bill's suggestion for board use during discussion following a lab
   1) record visual and numeric data kids provide
   2) let them articulate their conjectures in if-then form
   3) proofs of conjectures
   It worked beautifully! I was able to get all their ideas on the board and my own agenda. They naturally began to discuss which proofs ought to be attacked before others. It was a real good lesson.

C. The Science Group

The science group logged-in to the Network 182 times, somewhat less frequently than the geometry group, on the average of 26 log-ins each over twenty weeks. The data show that five of the seven teachers logged-in once a week or more, and that these teachers were likely to read all the messages in the heat and temperature forum as well as their private mail. Even those teachers who logged-in less frequently participated in the Network by reading both public and private messages. As in the geometry group, the advisor was by far the most active participant in terms of log-ins and message writing, although his messages were briefer, fewer, and more directly focused on

logistical and technical issues than the geometry advisors'. The advisor used the forum to post bulletins, encourage use of the forum, and to attempt to inspire reflective discussions around teaching with MBL. These efforts to influence participation included direct pleas, as well as specific questions relating to teaching practice. Direct pleas are illustrated in the following message text:

> Well, Sue seems to be the only one of us who got on during vacation. Hope you all get on soon and regularly!!!

According to log-files, only three of seven science teachers participated in the forum, and in each case responded to advisor attempts to initiate Network discussion that took place at either face-to-face meetings or on the Network. There are no examples of teachers introducing a topic or responding to one another in the forum. The following excerpt from the Network demonstrates an advisor attempt to initiate discussion and a teacher response:

> Sandy will be out soon but... in the meantime...I would be very curious to get some discussion going on what paperwork makes a laboratory exercise run best and what must be on that paperwork.??. What should the student have minimally done before, during and after the lab to get something out of the lab!!??

A teacher responded with the following:

> I think ideally each student should read through the procedure before an exercise is performed. However, this behavior really varies with the academic style of the students. Honor students will read, general students will lose the paper. I like the fill-in the data, answer the question format, for the sheets I use asking specific questions.

Log files and teacher interviews show that the science teachers wrote one public message for every ten private entries. Private entries ranged from two to 27 private messages during the twenty week sample period -- yielding a ratio of one private message sent every two log-ins. Whereas teachers sporadically wrote to one another in private mail, communication with the advisor occurred on a regular basis. Specifically, while three science teachers wrote to one another in private mail, all seven corresponded with the advisor. Teacher interviews indicate that these exchanges were initiated by both the advisor and the teachers, and that although the advisor made attempts to move discussion beyond the technical and logistical and toward the more reflective, his efforts were ineffective. On the other hand, interviews also show that the teachers who did communicate with one another via private mail were likely to combine their concern with the technology with discussions of underlying educational issues.

D. **The Programming Group**

Only three of the seven programming teachers logged-in to the Network and averaged ten log-ins over twenty weeks. The majority of these sessions occurred during the first month of the Network's existence. These teachers utilized the Network mainly to read all new messages in the forum and in private mail.

The group's use of the Network began with a series of public bulletins from the advisor that included meeting agendas, minutes, and attempts to initiate
discussion about the integration and modification of the Metacourse. In addition, in response to face-to-face discussions, a forum was added for teachers to place and search for programming exercises.

After an initial flurry of activity by researchers and advisors, with a few contributions by teachers, the programming group discontinued their use of the Network.

E. **Teacher Thoughts**

Teacher interviews reveal that most teachers saw the Network as a way to communicate with advisors between meetings by asking questions and gathering information. Teachers who did use the Network to communicate with other teachers viewed the Network as a way to disclose frustrations and see that others were sharing their concerns. As one teacher put it, "it's nice to see that I'm not alone, and that others are experiencing the same problems I am". On the other hand, another teacher who logged-in on a regular basis, said she discontinued her use because she felt disappointed when she did not receive responses to her messages. In her words, "one person talking to themselves doesn't do a lot of good".

Finding time to log-in to the Network was seen as a major problem by many teachers. Interviews and meeting minutes indicate that the time required for effective implementation of a teaching innovation, together with every day school pressures, left very little time to log-in to the Network. As one teacher said, "it was just one more thing to worry about". Another teacher stressed that, "it takes a lot of time to sort out what I want to say on the Network, time I don't have at school". A number of teachers remarked that learning how to upload and download would have eliminated some of this pressure by allowing them to read and write messages at their convenience.

Interviews also indicated that many teachers thought access to equipment at school was problematic. For many teachers, the time required to get to the computer, and for some, setting it up, was too much to fit into an already hectic day. Consideration of both time constraints and poor access led many teachers to believe that home access would be particularly helpful when trying to "think while writing".

A preliminary questionnaire showed that most teachers were unfamiliar with telecommunications technology. Five interviewees reported that trying to learn to use the telecommunications software in addition to a teaching innovation was too much at the start of the project. These teachers suggested that telecommunications training take place prior to the start of the project, so they would feel comfortable with one form of technology before facing another. The preliminary questionnaire also revealed that many teachers rarely used a word processor, and that two had never used a typewriter. Three teachers mentioned that their poor typing or word processing skills had kept them from being active on the Network. These teachers said that they sent messages only through private mail because they felt embarrassed to leave poorly typed messages for all members to read.

Many teachers reported not seeing the Network as having a specified function. Two teachers remarked that if there had been a required number of log-ins or an online project, they would have had a reason to log-in. Teachers also said that the Network was the "least desirable means of communication", and that they would exhaust all other means of communication before using the Network. Interviews demonstrate that each group had unique characteristics that contributed to this sense of the Network. Members of the programming group reported that some teachers were not comfortable expressing themselves in written form and therefore would only discuss their concerns at group meetings, on the phone, or with the advisor. Even advisor attempts to gather written feedback from teachers during meetings were unsuccessful. Geometry teachers said, "the Network couldn't capture the bantering back- and-forth and the quality of the group at meetings". They also remarked on the Network's inability to transmit graphics as limiting their ability to communicate with one another via the Network. The science advisor indicated that he met most of the teachers' need for communication though school visits, meetings, and phone conversations. In addition, three science teachers said that they didn't have a lot to talk about because they were teaching the unit at different times. As one teacher put it, "when Candy was doing the unit, I was already finished, and I really didn't have a lot to offer".

IV. CONCLUSIONS

The Lab Sites Network began with the hope that the Network would develop into an integral part of the project by serving as a place for teachers to give and seek collegial support. As the year went on it became apparent that while some teachers were using it for this purpose, the majority were benefiting from the Network by utilizing it as a resource to read messages and communicate with advisors. It is interesting to note that across all groups, the same teachers who were active at meetings were also more active on the Network.

Even though teachers logged-in an average of 1.5 times a week, many reported that they would have used the Network more frequently if they had had easier access to equipment. As it was often difficult for teachers to get to and find time to use equipment during school hours, most did not make logging-in to the Network part of their daily routine. In competition with everyday school pressures and the implementation of teaching innovations, use of the Network was often overlooked. These observations suggest that in order to eliminate time and access problems, teachers should have access at home. A review of the geometry group's use of the Network shows that teacher message writing increased greatly after they were given home access. Home access seems particularly important for a network which attempts to foster reflection on teaching practice, as it is only at home where teachers have time to do this type of thinking. While a teacher might have time to log-in at school, there is little time after reading messages to think through and write a response. Access and time pressures also suggest that in order to have time to carefully read messages and think through responses, teachers should learn uploading and downloading procedures.

Familiarity with typing, computers, and telecommunications all seemed to play a role in determining Network participation. Each group began the year learning a new method of teaching. In addition, many members of the science group were also attempting to acquaint themselves with computers. To master telecommunications at the this time had a lower priority for them than the immediate demand of their daily lessons. These findings indicate it might have been better for training to have taken place during the Summer when the teachers were not struggling to learn and integrate teaching innovations.

Typing skills also seemed to be essential to teachers' use of the Network. While a teacher may log-in and read once they have mastered telecommunications, poor typing skills may dissuade them from writing messages. Lab Sites teachers reporting poor typing skills said that the grueling and time-consuming process of typing kept them from writing messages on the Network. In addition, poor typing skills may have led teachers to send private messages because of embarrassment about exposing inadequately typed messages in public.

While the science group may have been uncomfortable with their typing skills, the programming group tended to be shy of written expression. As indicated in meeting minutes, these teachers were hesitant to submit written materials to the advisor. This tendency may have carried over to the Network in that these teachers may have preferred to participate through reading rather than writing. For all teachers, the risk involved in submitting a message in public mail for scrutiny by colleagues may have been too threatening, and messages may therefore have been sent through private mail for the eye of only one reader.

Another essential ingredient in the success of a network seems to be the provision of incentives for members to participate. Within the Lab Sites Network, it may have been that the opportunities for face-to-face collegial exchange made Network communication less necessary.

The geometry innovation, by its nature, demanded a great deal of collegial exchange. Through meetings in which the group took shared responsibility for learning, this need was met. The Network's promise of collegial exchange therefore may not have been enough of an incentive for the geometry teachers to use the system regularly to seek and offer reflections on teaching practice. Perhaps if there had been fewer face-to-face meetings, Network exchange may have served more centrally develop the support group required by the innovation. On the other hand, it could be that, since the asynchronous nature of the technology did not permit the banter that some members enjoyed at meetings, the Network's role in their communications was secondary.

In comparison to the geometry group, the programming and science groups did not seem to require the intensity of collegial support or exchange. Specifically, the programming teachers were familiar with the technology and BASIC curriculum, and the integration of the Metacourse into existing lessons went smoothly. Communication with colleagues did not seem to be essential to the effective implementation of the Metacourse. The science innovation also did not demand a great deal of collegial exchange. The diverse backgrounds and interests of the teachers, together with the fact that they utilized the Heat and Temperature unit at different times throughout the year, led to little need to communicate with one another either at meetings or on the Network. Since this group was new to computers and encountered technical troubles, the required support came from the advisor through meetings and school visits.

While the programming and science groups did not demonstrate a strong need for collegial support, assistance was required from the advisors. In particular, the advisor of the science group met the demand for consultations with teachers regarding technical concerns. Some members of the programming group finished the implementation of the Metacourse before the Network was in place; their need for any communication about research questions was met by the research staff.

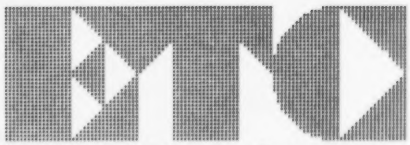
The study also suggests that, if teachers do not participate in collegial exchange at face-to-face meetings, it is unlikely that they will do so on an unfamiliar medium such as a computer network. When the need for collegial exchange and contact is met by other means, a computer network must provide special resources to motivate teachers to actively participate. These might include activities which directly facilitate their teaching work, or adjunct activities they may choose to initiate, such as on-line journals, or materials exchange. Reliance on a network for collegial exchange, may develop only in absence of face-to-face contact, as a result of geographic isolation or other circumstances.

The Network succeeded as an adjunct, but not as an integral part of, teachers' participation in the project. Although the Network did not become a place for teachers to reflect on their teaching practice in public forums, it did serve an important function by connecting teachers with advisors and other teachers through message reading and private mail exchanges. Even those teachers who were new to telecommunications and to computers made efforts to log-in on a fairly regular basis. In addition, the fact that some teachers did engage in reflective discussions of their teaching practice reveals that this medium has the potential to carry this type of communication.

APPENDIX C

Letters Inviting Old and New Members

to the 1987 Science Teachers' Network



Educational Technology Center

December 17, 1986

Dear Colleague:

Greetings! We hope you found your membership in last year's Science Teachers' Network both interesting and informative. As you may know, the Network staff has been working on a research report which describes some of the influences on participation, and which outlines general recommendations for educators who are planning to use this medium for similar purposes. The report will be available, upon request, in January.

The Science Teachers' Network project will begin again in January and run through June. Again, our goals are to promote collegial exchange among science teachers and to study factors which influence the nature and outcomes of discussion. Some of the activities planned will be similar to those of last year. We will ask members to moderate discussion in a number of forums, and will invite guests to discuss topics related to the interests of the majority of members. Based on last year's members' interest in safety issues, we have asked Jim Kaufman of Curry College to moderate a forum devoted to that purpose.

We currently would like to add as many new members as possible. We invite you to log-in to the Network, and to suggest membership to your colleagues. Members will be asked to participate in the research by completing one or two surveys and some may be asked to respond to one or two telephone interviews. If you would like to continue your membership through this year, please log-in to the Network by the end of January. If you have any questions or have forgotten your codename/password, please give me a call at (617) 495-9373. If any of your colleagues are interested in membership, please have them complete and return the enclosed application form to ETC (you may copy this form for additional teachers who are interested).

Have a wonderful holiday season!

Sincerely,

Kathryn S. Stroud

67

To: New Members of the ETC Science Teachers' Network

From: Network Staff

Date: January 15, 1987

Re: Continuation of exchange and discussion

Welcome to the 1987 continuation of the Network! We have entered you into the system with a codename of _____ and a password of _____. To change your password, please use the "set password" command described in the Common Ground manual. If you are not familiar with telecommunications equipment, you may wish to call Kathryn Stroud at ETC, 495-9373, for assistance.

Network activities will be devoted to discussions and exchange of information concerning science and science teaching. When you log-in you will see discussions that took place last year (please join in and contribute your ideas). If you would like to see a new discussion established, please enter a message in the appropriate forum introducing the topic. To propose a new forum, place a message in NB (Notice Board) asking if others are interested.

To help members get to know one another we request that participants enter a brief biographical sketch*, as soon as possible, into a forum titled BIOG. The procedure you follow is to send a message to BIOG, then enter your codename and real name, without punctuation, as the topic line. For example, the topic line might read as follows:

Eileen - Eileen McSwiney

We look forward to future conversations!

**** **** **** **** **** **** **** **** **** **** **** **** **** **** **** ****

*Suggested guidelines for biographical sketch are outlined below.

Name
School
Subjects Taught
Interests and Hobbies
A "Wish List" for information, materials, ideas, software, etc.
Information or materials you would like to share

Harvard Graduate School of Education 337 Gutman Library Appian Way Cambridge MA02138 (617) 495-9373

APPENDIX D

Teacher Interviews, Laboratory Sites Network

LAB SITES INTERVIEW March, 1987

It's halfway through the school year in the Lab Sites Project, and we wanted to have a chance to hear members thoughts and impressions about the useful kinds of communication among participants in the Lab Sites project and also about using a computer-conferencing network to support the adoption of a teaching innovation. We hope to learn from you about the ways that we might help make conferencing a more valuable means of communication both in the lab site project and in other similar projects, so we appreciate your frank and thoughtful comments to our questions.

1. **WHAT DO YOU THINK HAS INFLUENCED THE WAY THE NETWORK HAS BEEN USED OR NOT USED SO FAR?**

Probe if not mentioned:
a. access problems
b. teacher priorities

2. WHAT DO THINK HAVE BEEN THE MAIN PRIORITIES OF TEACHERS SO FAR THIS YEAR IN THEIR PARTICIPATION IN THE (GEOMETRY) GROUP?

3. OUR NEXT QUESTION IS A MORE HYPOTHETICAL ONE AND DOES NOT HAVE ANYTHING TO DO WITH THE NETWORK. WE DON'T KNOW IF YOU HAVE ANY OPINION ON THIS, BUT WE WERE WONDERING IF YOU WOULD COMMENT.

   A. HOW WOULD YOU DESCRIBE THE KINDS OF DISCUSSION THAT MIGHT TAKE PLACE IN THE EARLY STAGES OF AN INNOVATION BETWEEN TEACHERS AND ADVISORS AND AMONG TEACHERS THEMSELVES?

B. ONCE THEY HAVE HAD A BIT OF EXPERIENCE WITH THE INNOVATION, HOW WOULD YOU DESCRIBE THE KINDS OF DISCUSSION THAT MIGHT TAKE PLACE BETWEEN TEACHERS AND ADVISORS AND AMONG TEACHERS THEMSELVES?

For advisors and teachers who haven't yet had group meeting.

4. THE NEXT QUESTION IS SOMETHING WE HOPE TO EXPLORE MORE IN THE GROUP MEETINGS COMING UP, BUT WE WANT TO START THE PROCESS IN OUR OWN CONVERSATION AND HOPE THAT MAYBE THIS WILL HELP TO GET WHEELS TURNING.

For teachers who've already had group meeting

THE NEXT QUESTION IS ONE WE HOPE TO EXPLORE FURTHER AS THE YEAR GOES ON, BUT WE'D LIKE TO START THINKING ABOUT IT NOW WITH YOU AND HOPE THAT IF YOU HAVE ANY IDEAS IN THE FUTURE YOU WILL LET US KNOW ABOUT THEM.

IN WHAT SPECIFIC WAYS COULD THE NETWORK BE HELPFUL TO YOUR GROUP IN THE FUTURE?

HELPER If not much response to the above: WE HOPE TO BE GETTING MORE IDEAS ABOUT THESE THINGS, AND TO SEE WHAT KINDS OF THINGS TEACHERS MIGHT LIKE TO TALK ABOUT IN BETWEEN THEIR MONTHLY MEETINGS.

5. IS THERE ANYTHING WE COULD HELP YOU WITH CONCERNING THE USE OF THE NETWORK -- ANY QUESTIONS, OR MATERIALS OR ANYTHING?

Well, this is great, thank you, we are looking forward to hearing more about the goals of the spring work and how we might be able to help out.

LAB SITES INTERVIEW 5/23/87

NAME _____

INTERVIEWER _____

DATE _____

How was the rest of your year?

At the June 5th meeting I (Kathryn) mentioned that some members of the lab sites group would be selected for an interview, and you have been chosen. I understand that this has been a very busy year, as well as a year of rethinking your ways of teaching and learning. We're in the process of preparing our report on the potential of computer-conferencing in aiding communication among teachers in different kinds of projects. We're trying to understand the kinds of projects in which computer communication or is not helpful, and how. I'd like to talk to you about your experiences as a participant in the project. Some questions I'll ask you will be very broad, while others are specific to the network. Is it alright with you if I record the interview?

I. COMMUNICATION PATTERNS

I'd like to begin with some very basic questions.

1. How often were your group meetings?

2. Did you manage to make it to most of these meetings?

3. Were there times during the year when you would have liked to have had more contact with your group? For what purposes?

BEST COPY AVAILABLE

e. Did you get together with any of your group members in between meetings. What went on at these meetings?

f. Did you communicate with members of your group in any other ways (e.g. mail, phone, network, etc.)? What about?

II. CONTENT OF COMMUNICATION

We'd also like to talk to you about what you found it helpful to talk about with your group.

a. What types of discussions in your group were the most helpful to you during the Fall? (clarify between advisors and teachers.

a. Who introduced these topics for discussion?

b. What types of discussions in your group were the most helpful to you during the Spring? (clarify between advisors and teachers)

a. Who introduced these topics for discussion?

II. NETWORK COMMUNICATION

The next series of questions concerns the way you used the network.

1. In what forums did you typically read?

2. We've noticed that many people used private mail.

   a. Did you write messages in private mail?

   b. Did you write mainly to one person or to several?

   c. Did you receive messages in private mail? From whom?

   d. (For each person) what kinds of topics did you discuss with (Richard)?

      1. Did this change throughout the year? How?

   2. Who initiated these discussions?

3a. Did this change throughout the year? How?

3. Were there any exchanges on the network that you found particularly interesting? Why? What were they about?

4. Describe an exchange that took place on the network. Do you recall reading this discussion? What attracted you to the discussion? Why did you (or didn't you) respond?

IV. VIEW OF WHAT HAPPENED ON THE NETWORK

1. Do you think computer conferencing would be more useful once teachers have become more comfortable with using the computer? How?

2. If you had had more experience with computer conferencing before beginning your work on the lab sites project, do you think your use of the network might have been different? How?

3. If you had not been able to have group meetings during the week, do you think this would have influenced your choice of the network with any one?

4. If this had been the case, how do you think your network discussions would have compared to this year's face-to-face meetings for brainstorming and disagreements.

5. (For the geometry group) What about diagrams, if you had been able to transmit graphics over the network, how do you think your use of the system would have changed?

APPENDIX E

Teacher Interview, Science Teachers' Network

SCIENCE TEACHER'S NETWORK INTERVIEW

People used the Network for many reasons. Our purpose in doing this interview is to gather information in order to make recommendations to others who would like to begin a Network for teachers. So that we can make accurate recommendations, we would appreciate your being as frank as possible.

I. COMMUNICATION WITH COLLEAGUES

	Colleagues at School	Colleagues Outside School
1 a day or more		
A few times a week		
1 a week		
1 every few weeks		
1 a month		
1 a term		
1 a year or less		

A. Do you have colleagues at school with whom you talk to about science or science teaching?

1. At what times do you generally get together with these teachers? (prompt for meetings, over coffee, etc.)

2. For each setting:

   How often do (have meetings)?

   What types of things do you talk about at (meetings)?

B. Do you have colleagues outside your school with whom you talk about science or science teaching?

1. In what ways do you keep in contact with these teachers? (prompt for meetings, social gatherings, phone, etc.)

2. For each setting:

   How often do you have (meetings)?

   What types of things do you talk about at (meetings)?

II. <u>INITIAL IMPRESSIONS</u>

A. For what reasons did you join the Science Teachers' Network?

B. What were your initial impressions of the Network when you first logged-in?

III. BACKGROUND INFORMATION

New members only:

A. 1. Did you have any previous experience with telecommunications before you joined the STN?

Did you know how to word process before joining the STN?

Have you uploaded messages to the STN?

Do you download and print-out messages from the STN?

2. What would have helped you get over any difficulties you experienced when beginning to use the Network?

All Members:

B. Where was the phone line you used to log-in to the Network?

1. if home - Did you pay for the calls yourself?

if yes - Do you think that this influenced your use of the Network?

2. if school - Did you have access to the phone line at times you wanted to use the Network?

C. Was it hard for you to find time to log-in to the Network?

D. Had you ever met any of the STN members in person before joining the STN? If so, who?

1. For each person mentioned, ask:

Had you talked with him/her for more than five minutes altogether?

If no, so you know him/her by name or sight only?

IV. NETWORK COMMUNICATION

A. When you log into the Network, what do you typically do first?

B. What do you do next?

Private Mail

C. Do you recall writing to anyone in private mail? Who?

D. Do you recall receiving messages from anyone in private mail? Who?

E. For each person:

1. What did you talk about with (John)?

2. Who initiated these discussions?

Forum Writing

F. Do you recall participating in any forum discussions?

G. For each discussion mentioned:

As you recall, did you respond to somone elses message or initiate the topic?

H. Were the messages you wrote in forums in any way different from those you wrote in private mail? How?

I. Did you ever respond to a forum message in private mail? Why?

J. Did you ever write any messages (public or private) and not receive a response. How did you react to this?

READING

L. Did you have a special interest in a particular forum?

M. Did you ever upload or download messages? For what purposes?

N. Were there any discussions you did not participate in, but did find particularly interesting to read?

For each mentioned:

1. What about the discussion made you want to read it?

2. Did you feel involved in the discussion?

O. When you were reading in any of the forums, did you ever have a problem following the discussion? What made you feel this way?

V. VIEWS OF THE NETWORK

A. How has the Network served and not served your interests this year?

B. Did you get any teaching ideas, new science information, or an update on materials from the Network?

C. Do you feel you got to know anyone through reading and writing on the Network?

D. What did you find most puzzling about mastering the Network?

E. If you had been able to meet face-to-face with members of the Network, do you think the use of the Network would have changed? How?

F. What do you see as the best uses of computer-conferencing for science teachers.

APPENDIX F

Questionnaire on Previous Microcomputer Experience,

Laboratory Sites Teachers

LABORATORY SITES NETWORK

Name_____
Date_____

Please tell us about your equipment and typical use of wordprocessing so that we may facilitate future use of Common Ground for the lab sites.

1. How often do you use word processing in your...

	Never	Rarely	Some	Often (once a week or more)
a. teaching work?	___	___	___	___
b. personal work?	___	___	___	___

2. Where and what type of equipment do you have?

		Computer?	Printer?	Modem?	Com.Soft.?
a. home?		_____	_____	_____	_____
b. school?	(1)	_____	_____	_____	_____
	(2)	_____	_____	_____	_____

If at school, is the computer you prefer to use...

__in room you use often? __in another room.

__available at all times? _not always available.

3. If you use word processing in your teaching work,

a. what word processing program do you use?_____

b. what do you prepare?

__student tests
__student work sheet
__other (explain)

c. do you often prepare diagrams or other graphics for this work?

APPENDIX G

Questionnaire on Previous Acquaintanceship with Other Members

Science Teachers' Network

June 5th, 1987

Dear Science Teachers' Network Member:

Please assist our research on the Science Teachers' Network, and help other future networks, by completing the attached questionnaire. This information will help us to understand communication patterns among members. As you may know, you will receive a complete report on this and all the other analyses about the network in the early fall.

For each name on the attached list, please check your answer on two scales. Think back to BEFORE you logged on to the network.

Scale A: ACQUAINTANCESHIP: check one of the following categories:

O: When I first logged on to the network, I had never heard of this person.

N: When I first logged on to the network, I had heard of NAME only and never seen him/her in person.

S: When I first logged on to the network, I had SEEN person only and never talked with him/her.

T-: When I first logged on to the network, I had TALKED with him/her very LITTLE (less than 5 mins.total)

T+: When I first logged on to the network I had TALKED with him/her some or ALOT (5 mins. or more total)

Terms:

"talked with": had a verbal exchange in person or by phone, or as part of a small group interacting with person, even if you personally didn't talk with person.

"five minutes or more": a total of roughly five minutes or more in your whole life.

Scale E: KNOWN AS EXPERT: If you had heard of the person, check one of the following. (If your answer to Scale A is 0, you may skip this scale.)

E: When I first logged on to the network, I had heard that this person was known to others as an EXPERT science teacher, scientist, or educator (in science or other fields).

P: ...Possibly a known expert/I'm not sure/ I don't think person is known as expert.

Terms:

"known to others as an expert...": your impression was that the person had some reputation or was recognized by others to be an expert (whether or not you agree that they are expert).

"science teacher, scientist, educator": your own definition of these terms is acceptable for the purposes of this questionnaire.

Although we don't consider this information any potential source of embarrassment, we still want to insure the maximum confidentiality of your responses, and also don't want our knowledge of your responses to bias any of our own analyses. Therefore we ask you to write your name only at the bottom of this page. As soon as we receive it back, we will write a code number on the actual questionnaire without looking at the responses (we promise!). The questionnaire will be identified only with a code number as it is being analyzed.

This should take 5-15 minutes to complete. Please mail these pages back to us in the enclosed stamped envelope by June 15 and many many thanks for your help!

---------- ----------

Your name Date

For each person, please check one category on each scale.

When I FIRST logged on to the network, to me this person was:
ACQ: O:unknown N: I knew by name only S:knew by sight, never talked
T-:had talked <5 mins. T+:had talked >5 mins.
EXP: E:a known expert P: possibly a known expert, or not a known expert

---

	Acq.					Exp.	
	O	N	S	T-	T+	E	P
roger - Roger Perry - Plymouth-Carver School	--	--	--	--	--	--	--
fredc - Fred Cawthorne - North Quincy H.S.	--	--	--	--	--	--	--
chriss - Chris Smick - Rivers School	--	--	--	--	--	--	--
carolf - Carol Frey	--	--	--	--	--	--	--
robert - Robert Akeson - Boston Latin H.S.	--	--	--	--	--	--	--
josephw - Joseph Wa' oston Latin	--	--	--	--	--	--	--
marti - Marti I in H.S.	--	--	--	--	--	--	--
kathleen - Brookline H.S.	--	--	--	--	--	--	--
markr	--	--	--	--	--	--	--
r .l.S.	--	--	--	--	--	--	--
l sample page own H.S.	--	--	--	--	--	--	--
bev n H.S.	--	--	--	--	--	--	--
ralph Blue Hills Trailside Museum	--	--	--	--	--	--	--
harrym - eserve - Arlington H.S.	--	--	--	--	--	--	--
chrisw - Ci is Whittle - English H.S.	--	--	--	--	--	--	--
ian - Ian Tiswell - Harvard Physics	--	--	--	--	--	--	--
skehan - Dr. Skehan - Weston Observatory	--	--	--	--	--	--	--
judith - Judith Kelley - Univ. of Lowell	--	--	--	--	--	--	--
jaks - James Kaufman - Lab Safety Expert	--	--	--	--	--	--	--

APPENDIX H

A Discourse Analysis of Four Interactions on the ETC Science Teachers' Network

Moira Inghilleri

A Discourse Analysis of 4 Interactions: The Science Teachers Network

Moira Inghilleri

Computer networking is a communicative event which, in many ways, has yet to be characterized or defined in terms of its contextual features. In the Science Teachers' Network, for example, while certain relevant characteristics can be identifed e.g. the members of the network are either science educators presently teaching in a secondary school or guest specialists involved in other science-related ventures, the message form is written, and members are involved in diologic exchanges for the purpose of collegial exchange, what do these features tell us about how the members actually experience the event? Do their interactions on the network appear to them as diologic exchanges or are many people perceived to be participating? Does the formality or informality of a message vary amongst participants and, if so, what does this indicate about the way they view the speech event, i.e. when messages assume a more formal tone as say in a letter, does this imply that the composer of the message perceives the communication as a written exchange as opposed to a face to face encounter? Does the format, the actual physical appearance, of a message effect the reader's perception of the sender or the content of the message? How do members approach one another, e.g. as strangers, colleagues, superiors, etc. and how is this expressed in the language?

In this outline I would like to address some of these issues by presenting a detailed discourse analysis of several exchanges on the network. My intent is not to provide or imply any strong conclusions, in fact, I raise the above questions hoping they might in turn raise more questions regarding the nature of computer networking.

In analyzing the following texts, it became clear that in a network exchange, just as in "normal" conversational exchanges, much conversational inferencing must and does occur. This may influence both how the apparent intent of an individual in introducing a topic is perceived by the other participants and how that intent may or may not be altered as a result. In the exchanges presented here, I will attempt to first identify the apparent intent of an individual's message in a particular exchange, and the other participants' interpretations of the sender's intent. I will then locate in the talk how this topic gets negotiated and how and when appropriation of knowledge and ideas seems to occur amongst the participants.

The first example I present is the "Textbook Exchange" which occurred in the Biology Forum from 2/28/86 until 4/2/86. This exchange illustrates how topics get negotiated within an exchange based on what might be considered the personal agendas of those who choose to participate. Red begins this exchange seeking information regarding textbooks and computer information for low level biology classes (msg no. 1841 2/28/86):

Would you tell me: 1. What book you use for your low level biology classes 2. Do you use any computer assisted teaching in your classes? 3. Any recommendations on appropriate software for low or average level biology classes? Thank you for your time!

Maurice responds to this mesage with the following comment (msg no. 1855 3/2/86):

At C[redacted] High School we have 4 levels of biology for the 10th grade. For the Honor students we use the BSCS Blue version, for the level 2 college level we use Modern Biology, for level 3 a lower college level we use Scott, Foresman, and Co. "biology", and for the level 4 class we

use Action Biology. In the level 4 class half the students can or will not read, so I am not sure if any text is of great value. We have had a great summer workshop just to develop teaching materials for that level. If you do run across a book that can excite a group of poor ability and poorly motivated but smart students, I think you will have found a great text.

In his response, Maurice provides a list of texts which he uses for all different levels of students. By naming the other texts, he provides information to Red about his sense of what low level means, and then expresses frustration regarding materials for these students for whom no text seems to be appropriate. Red responds to this expression of frustration by offering Maurice information regarding the textbook he uses (msg no. 3/5/87):

The text books that I use in my low level biology classes are: At North High School we use the Charles Merrill Co Series of paper backs, they include: 1. Reproduction and Heredity 2. Human Biology 3. Microbes and Disease 4. Plants and Animals These texts are quite simple and do seem to present no great problem to the low level 9the and 10th grade. I like them but I don't love them. Because they are paper back they do get beat up, but thats nothing new for low level groups. The trouble is that they get lost more easily than hard cover books. North High in Worcester does have a great many low socio/economic students, but this book has been as successful as any that I have tries in the lasst 18 years of teaching.

It seems as if in Red's original question he might have actually been seeking information regarding texts other than the one he was currently using, but his question was interpreted by Maurice as seeking any information. With his response, Red acknowleges Maurice's response to him, yet implies that it wasn't the answer he was looking for. In addition, he attempts to indicate that he is not as uninformed as perhaps Maurice understood by mentioning that he has been teaching for 18 years. Interestingly,

Maurice's next response displays somewhat more deference to Red this time (msg no. 1937 3/6/86):

Thanks for the information on the Merril Co. series. I will have to try to look them up. My main problems with the low level books have been content. So many of my low students are smart, but not motivated that the books do not have enough information in them to keep the students happy. I guess that is why we are always adding our own labs and worksheets. We always know more than the experts do?

It appears as though Maurice may have felt that he had misinterpreted Red's first request and thus makes attempts to repair this with such comments as ...Thanks....I will have to try...I guess...before ending in a questioning tone.

Rose enters into the conversation to tell Red that she is using the same textbook for low level students and responds to his initial request for software information (msg no. 2003 3/11/86):

We have recently adopted Merril's Biology An Everyday Experience for our low level biology students. No software is being used with these classes...yet!

At this point, Red has received responses to his question but it is still not clear if he merely wanted to know what others were using or if he wanted to know about texts other than the one he was using.

When Vicki enters the discussion, she asks about texts for advanced classes (msg no. 2183 3/26/86 and msg no. 2243 3/31/87):

At [redacted] we are evaluating textbooks for our "highest" level bio classes. So far we like Scott, Foresman BSCS Blue, CEBCO, and MacMillan. Does anyone have any experience of the latter? We are trying to narrow down the choices, and are searching for a text which helps students sustain excitement in the broad

ideas in the subject. Many texts seem dull; it's hard to compete with Miami Vice! Any comments would be greatly appreciated; thanks!

and,

[redacted]s preliminary meeting to select a top level first year bio text has resulted in these books as finalists: Scott Foresman, MacMillan, BSCS Blue, Silver-Burdett, Heath. Does anyone have any advice about any or all of these? Our students in that group have a wide range of abilities, so we would like a text accessible to everyone. Thanks for your comments.

For Vicki then, the topic is textbooks, not low level students. In contrast, Rrh `hears' the topic as lower level texts, however, he also brings in another topic (which was being discussed between Maurice and Rose in a separate exchange), that of what to teach (msg no. 2196 3/27/87):

There seems to be an interest in finding good materials for lower level students, herein defined as probably not going to any 2 year college or to a trade school etc. (Not that trade schools are all that easy, mind you.)

We are also struggling with the same problem - what to teach and how to teach it.

I think that anyone who does anything successful at all should be listed on this forum and ideas spread around.

Maybe we could get a conference started on approaching these difficult students. At least in our school we have recognized we are not serving them well (in most fields, including science.)

It is interesting to note that Rrh names this message "low level texts" but his final comments suggest that he is interested in a much broader discussion, i.e. how to better serve low level students in general. Although Maurice and Rose have not been discussing what to teach to low level students (but, in general terms, how to choose amongst the vast subject matter within biology), Rrh uses their theme to elaborate his interest in low level students.

At Vicki's next turn, she continues on her topic of textbook evaluation. She decides finally to enter into the low level textbook discussion, by informing the forum that she has had success with the same text that Red has used (msg no. 2279 4/2/86):

We've tried one section of our low level students on Merrill, An Everyday Experience and it seems to be working quite well; good workbook activities. Software use is in the future, hopefully.

There are a number of interesting observations in this exchange. First, what was being talked about was judged differently at different points by different participants, e.g. Vicki vs. Rrh. Second, it appears that the written messages themselves do not always reflect the composer's topic (just as it is not sentences that have topics but the speakers who utter them). For example, it is unclear whether or not Red ever got the answer he was looking for because of the way he phrased the question, what book do you use etc.. Did he want to know how many others used the same book as he or was he hoping for new information regarding other texts?

Both the ambiguous phrasing of Red's question and each participants' personal agenda seem to contribute to the emergence of new topics either for the initiator of the exchange or those who engage in it at different points later on. Another notable aspect of the exchange between Maurice and Red is the repair Maurice seems to attempt as a result of having misinterpreted Red's request. It has been established that `face' is emotionally invested in conversational exchanges and that as speakers and hearers we avoid face threatening acts so as not to belittle or impose upon each other. When this occurs or we think this has occurred, we use indirect or direct means to repair

the threat. It appears that this may be what is going on between Red and Maurice. It may also be interesting to consider whether the rather disordered format of Red's first message may have contributed to the tone of Maurice's response. Just as paralinguistic cues in oral speech often provides clues as to meaning, so does the appearance of written text often contribute to both how the message is understood and how the sender is perceived by the reader.

A similar case of ambiguity in an initial request can be found in the "Static Electricity" exchange which took place in the Physics Forum from 4/2/86 until 4/19/86. Tad begins this exchange with a request (msg no. 2281 4/2/86):

I am having increasing difficulty getting large enough static charges by rubbing a plastic rod with silk. Any suggestions.

The ambiguity here lies in whether or not Tad was seeking information about alternative methods or if he was interested in knowing why his difficulties were increasing and what he could do to prevent this from occurring. The responses that Tad receives reflect the differing interpretations that emerge as a result.

The first response by Bill is itself somewhat ambiguous (msg no. 2282 4/2/86):

For 25 years I have had the same problem. Is there any particular reason you want to use plastic aand sik vs.some better way of getting static charge? Some kind of fur (rabbit) does a good job.

It is not clear what problem he has had for 25 years; that of geting static charges or using plastic and silk. It seems it may be the latter since he suggests using

something else, however, his suggestion is rather vague and unelaborated. Daveoh, the second respondent, deals with the ambiguity of Tad's request by treating it as two separate issues (msg no. 2284 4/2/86):

No special hint on plastic/silk static charge problem. But I have found I can use a 6 foot piece of scrap carpet, 1 foot wide, on the floor and shuffle my self--shod with shoes--back & forth enough to get a a coffee can electroscope, with swinging needle & metallized straw, to move quite a bit.

He states that he cannot provide information regarding the plastic/silk problem (thus acknowledging that this may be Tad's request) but he can provide an alternative solution.

When Chris enters on the third turn, he turns to the issue of <u>increasing difficulty</u> (msg no. 2311 4/4/86):

Tad, I'm intrigued that your difficulties with plastic rod and silk have been increasing. Maybe your silk is getting old? Or perhaps there has been a shift in the Van Allen belts?

Chris' treatment of Tad's request may be reflective of his role on the network as a kind of unofficial facilitator/contributor. His comments suggest that he is interested in the perhaps larger issues which Tad's dilemma raises, as he states , he is "intrigued" that the difficulties are increasing. His response creates a new tone to the exchange, one which encourages a broadening of the discussion away from simply providing alternative methods. The next two repondents, Victor and Daveoh, pick up on this shift in focus and discuss the problem of the plastic charges and the silk.

Victor (msg no.2335 4/6/86): Static electricity generation isstrongly affected by the humidity. Higher humidity dissipates statci charges quickly, which is why

you are more likely to get shocked in the winter than in the summer by shuffling feet on a carpet. If you can, scheduling static experiments while the heat is on (drier air) may alleviate the problem.

Daveoh (msg no. 2344 4/6/86): I sent something on this before, but it well may be the glass/silk difficulty is due, as someone else suggested, to the "tiredness" of the silk. Not a very scientific term, admittedly, but I mean as the slik hads been used over a number of years, the spaces between its fibers may have become filled with little bits of dust & crud from the rods, from hands of students, etc. How about putting the silk through the laundry? Maybe that would help.

When Helen enters the conversation, she address several of the points previously raised. She offers an alternative method which also involves plastic and acknowledges Victor's comments about the weather factor (msg no. 2421 4/11/86):

Yet another suggestion on the subject. If you rub an ordinary plastic ruler (the dime store variety) with plastic wrap (Saran, etc.) the ruler will become positively charged. The charge ccan be demonstrated by hanging the ruler on a thread attached to the midpoint, and then bringing another charged ruler near one end. The rulers come conveniently punched with holes to fit a three-hole ( ) socket so hanging them is easy. I've found this demonstration works like a charm even in damp weather. It's particularly nice because it shows so many things. You can show, for example, that when the ruler becomes positively charged the Saran wrap becomes negatively charged, thus demonstrating charge conservation. Hope this will be helpful to someone.

The final contribution by Jaks provides a good example of how topics can be manipulated to also include a participant's personal agenda. In this case he does not have to negotiate for a shift in topic, he merely combines the static electricity issue with his interest in safety (msg no. 2497 4/19/86):

My favorite static electricity demonstration is the Kelvin Water Dropper. Water flows from a one liter reservoir into two small soup cans. In the process (and

due to the arrrangements of the parts) a sufficient static charge is built up to cause five small nixie tubes to flash every four to seven seconds. Most impressive.

I use this at the start of most safety presentations to emphasize the notion that life is filled with hazards. Many that we never knew about or if we did, we forgot.

In this case, the static electricity can be an ignition source. If you are pouring a flammable liquid (ether, hexane, pentane, ligroin, petroleum ether, etc.) be sure to keep the two containers in contact so that they don't develop a charge differential.

Use ground wires and bond wires for larger containers.

A Mid-Western Professor and his grad student were seriously injured when the ether they were pouring from a five gallon can exploded. They were hospitalized for six months. Required extensive plastic surgery. Destroyed the lab and ten years of research. The professors relationship with his grad student did not fare so well either!

One question which this exchange raises concerns topic development. Is topic negotiation and development more likely to occur when a request is ambiguous in nature or do personal agendas emerge regardless, based on individual agendas or perceptions of the function of the network. For example, as we saw in the "Textbook Exchange", Red's request for textbook information elicited a range of comments, none of which we can be sure helped him out in terms of his initial request. In the same way, Tad's request resulted in a variety of responses which may or may not have been helpful to him. Did the ambiguity in each of these requests actually serve to help the initiators by providing a wider range of possible solutions/responses to their problems or did it encourage responses which did not address the problems for which the composers of the original message hoped to find solutions? On the part of the readers, did the ambiguous nature of the questions make responding more difficult or did it encourage/support/ faciilitate

readers focusing on their own "topics", i.e that aspect of the discussion which most interested them. Helen's comment, "Hope this will be helpful to someone", at the end of her message is interesting to note. It is as if her suggestion is not addressed to Tad but to the discusion which has ensued as a result of his initial request. This may suggest that as topics unfold into a discussion they become forum topics and not topics of the individual's themselves.

I will now turn to two additional exchanges, the "Stoichiometry" exchange which took place from 5/17/87 until 6/13/87 in the Chemistry Forum and "Charlie's Musings" which took place in the Teaching Forum from 2/19/87 until 2/23/87. Although they initially involved similar topics and the same participants, the two exchanges developed remarkably different themes and tones.

"Charlie's Musings" begins with his introducing a review by H.M. Levin regarding "occupational misdirection of education". This exchange, located in the Teaching Forum, develops into a discussion about teaching science, topics for contemporary science, "students needs in the real world" (Ralph). The four participants involved, Charlie, Chris W., Ralph, and Jaks, contribute both on a practical level (by suggesting actual classroom projects and topics) and also at the level of discussion.

Charlie (msg no.4265 2/19/87): H.M. Levin, Stanford University, (in his reviewing "Low Tech Education in a High Tech World" in SCIENCE, 13 Feb 87, p799) suggests that our foreign trade deficit and low manufacturing competitiveness in NOT due to a poor labor force and their inadequate education, but is due to value of dollar, poor management decisions, etc. However Levin states our educational system is on a collision course

with failure to have occupational preparedness. Much stress is being put on "high tech" in spite of there being only 5% of U.S. jobs are technologically oriented that require two years of college or more. Most job growth is in low wage and low educational level such as clerical, retail, fast-food, amd medical aid jobs. Occupations which have adopted microprocessor technologies have moved to lower skill requirements than before. That is less analytical and tech skills are now required in printing, banking, computer utilization, and electronic machine repair.

In addition to over occupational misdirection of education, Levin continues that a major threat to the economy is that educational institutions have a tremendous number of disadvantaged students. 30% of present enrollments in U.S. schools have cultural differences, non-English languages, poverty, etc. such that they do not substantially benefit from their school years. They leave school lacking elementary skills in reading, writing, computation, and reasoning.

How is this in response to Levin's concerns? Instead of my teaching 108 students in 4 standard chemistry classes and 3 "CONTEMPORARY SCIENCE" classes, 1 std chem, and 1 hon chem. The CONTEMPORARY SCIENCE would cover several topics in the year. The only two topics that I can think of at the moment are FIRE FATALITIES (U.S. has almost double that rest of the world in its loss of life due to fires) and IMPLICATIONS OF DATA IN WORLD ALMANAC. In this new course I would soft pedal the topics molecules, moles, ideal gases, equations, molarity, and tetrahedron that are in "orthodox chemistry".

Would appreciate any reactions to above.
i.e.....think it would get administrative support?
.....think students would get a greater benefit?
.....if silence is appropriate, do you have some Catch 22's?

Chrisw (msg no. 4274 2/20/87): I am just beginnning to understand the workings of the minds of "disadvantaged" students. 90% of my students fit in this category. The BPS curriculum is deficient in that it does not relate to the students experience.

As for chemistry: I only used high school chemistry in college chemistry. My advice is to identify those students going into science or academically gifted and teach them traditional chemistry. Design a new course, conntemporary science problems, using the newspaper or discover magazine as a primary text and researching

topics and techniques. Heavy on labs and demonstrations, use science TV video tapes. I.m sure you and your students will enjoy it and use it more than stoichiomentry.

Jaks (msg no. 4286 2/22/87): You might like our introductory science course at Curry. The course, The Sciences-Approaches to the Natural World, is a multidisciplinary, team taught terminal course for liberal arts students. One version is an introduction to environmental science taught by biologist Chuck Towle and me (the chemist). We have a great time talking about understanding the environment, population, elementary ecology, resources, energy, pollution, solutions to problems not just problems, how science works, and of course - a few examples of general health and safety!

Ralph (msg no. 4295 2/23/87): Charlie's message #4265 raises some important issues. I like the idea of teaching science based on current events and students needs in the "real world". This has long been the approach of environmental education, which recognizes pressing problems in the contemporary world that require an educated citizenry in order to solve them.

What does a person need to know and understand in order function effectively in his/her world? In this world one needs to understand science, as well as the Three R's. -- science as it relates to the context of our lives.

For example: The other day an otherwise very well educated nature adult told that the solution to Video Display Terminal hazards is to place a crystal somewhere near the monitor. The crystal will, she said, soak up the radiation and protect the operator from harm. She later gave me an advertisement for a lead screen that is being sold to palce over computer monitors to filter out x-rays.

The crystal idea is bunk--pure pseudo-science. Just about any of the groups that are concerned about VDT hazards willl tell you that the x-rays from monitors are not significant and the lead screens are a waste of money (I called a couple and asked).

My friend does not have a sufficient knowledge of science to approach an important contemporary problem in a very effective way. Such people are easy victims for people who want to take their money and leave behind a very false sense of security.

Here are some suggested topics for a course in Contemporary Science:

1. TV and VDT hazards. The nature of the debate. The hidden agendas and biases underlying the various speakers in the debate. Health effects of stress and strain (muscles,visual,etc.). Ionizing and non-ionizing radiation. The need to make decisions in the absence of conclusive information. How to do this.

2.How to lie with statistics. Examinationns /evaluations of media advertising.

3. Asbestos hazards and lead poisoning. Our knowledge of hazards changes with time as new informaiton is developed. Evaluatinng hazards -- when is action required. The history of these pollutants. Issues of health hazards and economic costs/benefits. The political process for dealing with these issues. Local examples. Inspect your own home for these hazards. (Acid rain and radon hazards provide similar examples.)

4. Nuclear power. The physics of nuclear generation of electricity. The history of the industry. Real, potential and fantasized hazards. Pick a plant for ddetailed examination. What should happen with Seabrook? (Antioch/New England has developed an exceptionally fine curriculum package onn this issue area -- "Know Nukes". Leave a message in my mailbox and I will send you information about it.

5. A glass of water. We take our drinking water for granted, which is unfortunate. Our water supplies are in danger. Groundwater pollution is spreading and a number of town have already lost their town water supplies. The MDC water system (supplied from Quabbin Reservoir) is said to be inadequate to meet future needs (a point of debate) and there is a proposal to augment it by diverting water from teh Connecticut River (another topic of considerable debate). [Correction: it is no longer MDC water -- the Massachusetts Water Resources Authority (MWRA) is now the agency in charge.) What are the chemicals poisoning our water? How can we deal with this problem? What are the health hazards?

6. Boston Harbor. THe pollution problem and methods of dealing with it.

7. Road Salt. Poisons water supplies, destroys bridges and road surfaces, and eats up our vehicles. There are more deaths on salted roads than unsalted. Why is it used? How does it work. How does it create problems? What can we do?

And it can go on.....

These are issues that impact our lives and those of our students. AN undestanding of science, both content and process,is an important part of any effort to find solutions. Are our science courses designed to help our students function in this very real world? How can we do a better job of it?

The "Stoichiometry" exchange begins with Chris W. raising a similar issue. However, he identifies the topic more explicitly to be stoichiometry, why do we teach it. He had mentioned this in the previous exchange when the discussion had centered around the issue of traditional vs. contemporary chemistry ("I'm sure you and your students will enjoy it and use it more than stoichiometry"). He begins (msg no. 4881 5/17/87):

RE: Stoichiometry
Why do we teach it? The only people who use it are chemists. Do chemistry teachers have trouble finding homework assignments without it?

Bruce, the moderator picks up on Chris' comment, especially relating it to teachers (msg no. 4889 5/18/87):

Good question Chris?!?!?! Truth is stoich seems to be the meat of every chem course. Could it be that the fundamental relationships in a chemical equation form the basis for most of a high school chem course? Could it be that the unit analysis techniques learned in stoichiometric relationships are, indeed, useful in other areas? Are these rationalizations for the chem teachers existance.???

When Jaks enters the conversation, he responds to Chris' comment that "the only people who use it are chemists" and begins, "Stoichiometry is also used by chemical engineers". This sets the tone for what develops into a somewhat heated debate around the issue of the quantitative vs. the qualitative aspects of science (msg no. 4944 5/25/87):

Stoichiometry is also used by chemical engineers. It is indispensible for chemical manufacturers who want to know how much x they can make from y pounds of z.

Furthermore, the calculation of % yield and understanding the concept of limiting reagent are particularly of value outside of chemistry.

Stoichiometry calculations for chemistry students is not the same as pulling wings from flies and watching them try to take off!

Science is quantitative. Don't avoid teaching its qualitative aspects like stoichiometry. Otherwise, you'll have students who have no real sense of what "more/less/dilute/concentrated/TLV/ppm/ppb/ etc really represent? They'll have not a clue what it means to make a measurement and what it represents in chemical systems.

Chris responds with the following (msg. no. 4952 5/25/87):

My point is are we letting the quantitative aspects of chemistry and physics scare off many students who could benefit from an understanding of qualitative science - the kind we use everyday.

Jaks (msg. no. 4977 5/30/87): There are probably many students who could benefit from a less quantitative version of physical science. One of the problems is deciding it's important enough to do so that you become willing to give up something else. We still want scientists who can use and understand numbers.

Chris (msg. no. 4980 5/31/87):Sure we want scientists who can understand #s. We want everybody to understand #s. But truthfully - how many of your students become "scientists"? We want everyone to understand science not just those people who understand #s. #s are simply another language of man. We do not have to teach science bilingually - in English and Math - English should be good enough for teachers and those 90% of students that don's choose "science" and go into normal life.

At this point Charlie enters the conversation, attempting to somehow moderate the debate (msg. no. 4986 5/31/87):

...with regard to weight problems in chemistry...any H.S. student aiming for future studies beyond junior college should be able to handle the abstractions of symbols, formulas, equations, moles, and weight problems. This is a BIG HURDLE (those having deficits in long division and with decimals have a terrible time). The teacher should intersperse these abstractions with topics of descriptive chemistry.

Those students without academic plans and those with weak academic work habits should be immersed iin a different chemistry course - a non-quantitative, a "phenomenal" chemistry. Problems that face the teacher is that no publishers seem to put out a suitable textbook - ACTION CHEMISTRY is terrible (it goes into all the abstractions of standard chem textbooks, but in fewer words and with more confusion). I have set up many worksheets so I could handle the course without a standard textbook.

NOW THE BIG ISSUE - THE PEOPLE PROBLEM. Some teachers achieve class control or discipline by OBFUSCATION. SImple ideas are obscured so students are constantly kept of blanace. And some students are not able to bring a book to class, are not able to bring a mind to class that is not encumbered by "General Hospital" type problems, that are "bored" by anything but bells and whistles, and attend class only sporadically - i.e. the in-school dropout.

Weight problems are simple.

People problems are CATCH-22's.

Chrisw (msg no. 4988 5/31/87): Bravo. Euthanasia may be the answer to the people problem or at lease a mandated system of world wide birth control so that the population returns to a more natural level - giving everyone the resources they need to prevail.

What schools offer qualitative physics and chem courses?

Jaks (msg no. 4997 6/2/87): If you want to offer different levels of chemistry and that's a luxury your community can afford community can afford -- bravo. Physical science without an appreciationof the quantitative aspect is not my idea of science. Science is making measurements on nature. Removing the bias of the investigator. Establishing controlled experiments. Confirming reproducibility of results...etc.

Now I'd be the first one to argue that the traditional curriculum ought to be changed to include the one thing that science lab can teach that will be of some real value later on - how to identify hazards and how to protect yourself from thosee hazards. However, don't forget to make it appropriately quantitative.

Perhaps we need to learn how to teach the quantitative aspects and now to teach qualitative chemistry to math shy students.

Chrisw (msg no. 5004 6/3/87): An understanding of chemical and physical properties of matter is not a luxury. They are a requirement in our complex socirty. Are our citizens only to be expected to understand nuclear fusion and acid rain if they take courses for the college bound? The fact that chemistry and physics are college bound courses requiring chemistry is not verification that that is how they will be taught but is a throwback to a simpler time when only those going to college needed to know of such things.

Look at earth science, astronomy, geology, oceanography, & meteorology. All these could be taught quantitatively but they aren't because the math has little to do with understanding the concepts.

Let us not rebel against an idea whose time has come just because we've always done it that way. We cannot allow important information to be kept from people just because they choose not to go to college. Are we to turn our backs on the majority of our urban and rural students?

Jaks and Chris exchange strong ideas about the importance of teaching science quantitatively. While Chris seems to be reiterating the ideas he had raised in the discussion in the Teaching Forum, Jaks seems to perceive the discussion at another level entirely. There may be several reasons for this.

The fact that the "Charlie's Musings" discussion took place in the teaching forum may have placed it in a different context for Jaks. Later, when a similar topic was discussed in the Chemistry Forum, he may have perceived it as related more specifically to chemistry and less to science in general. In the teaching forum, he mentions liberal arts students and introductory science courses, yet in the "Stoichiometry" discussion, he never makes a distinction as to what students he is referring to when he says, for example, "physical science without an appreciation of the quantitative aspects is not my idea of science".

Another factor might be that Charlie introduces his ideas with reference to an "expert", based on an article which has appeared in SCIENCE, a prestigious scholarly journal. Chris W., on the other hand, begins with a strong statement that reflects his personal opinion. This is immediately picked up on by Jaks who responds by emphatically disputing this opinion.

These examples suggest that Forums may serve as differing "contexts" for users and that this may in turn reflect the type of message that is left or the kind of exchange that occurs.

Although the debate between Jaks and Chrisw ends at this point, the discussion is pusued by three other members of the network, Ralph, Bruce, and Judith. Their comments are interesting to note in that each of them takes a different approach toward continuing the exchange. Ralph appears to attempt to validate both of their opinions (msg no. 5007 6/3/87):

I agree with the notion that chemistry can be taught in both qualitative and quantitative versions. Each has strengths and weaknesses. Ideall, everyone would be eager for the quantitative approach. Realistically, and pragmatically, other approaches should also be used.

We cannot afford to educate a citizenry that is uneducated in the sciences, including chemsitry. Scinece is an important tool, necessary if one is to understand the present social, political, ecological, and technical world in which we all live.

It is important, though, that if the quantitative approach is not taken the students should at least understand and appreciate the utility and importance of employing quantitative methods -- even if they are not able to evaluate competing claims in some critical manner.

Bruce, in his role as moderator, seems to push the issue, raising more questions in an attempt to broaden the discussion even further (msg no. 5068 6/12/87):

The discussion here reminds me of the first time my son's pediatrician was balling out my first grade teacher - wife for counting off for spelling. "Ridiculous", said he, "Noone will need to know how to spell with spelling checkers and word processing and the like".

Hmmmmmm. Spelling checkers do abound. Word processors make the worst penmanship look good. Does he have a point? And, is it applicable to the discussion on Quant - Qual? Is it possible that we should be teaching kids how to use black boxes? Is it good that you only have to push "hamburger" on the "cash register" at the Big M? Do UPC codes and scanners make addition and subtraction obsolete??

What is the "wave" of the future?

Finally, Judith provides some practical information regarding the issues raised in the debate (msg no. 5080 6/13/87:

Have any of you heard much yet about the new high school chemistry course developed by the American Chemical Society and the National Science Foundation? It's called ChemComm for Chemistry in the Community.

The course was developed to address some of the concerns brought up by chris and others. As I understand it, the course includes a lot more organic chemistry (rather than inorganic and pchem) in an effort to introduce students to the connection between chemistry symbols and what's going on in their lives. It would not replace AP chem, but would be suitable for anyone. Ther's to be a presentation on it at this summer's NEACT conference, 3rd week of August, UMass Amherst. Nancy Graves at Hamilton-Wenham HS is assistant registrar and could answer any questions you might have, if you are interested in this part (or all) of the New England Assoc of Chem Teachers 1987 summer conference.